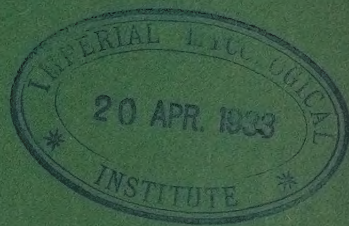


UGANDA PROTECTORATE.



ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

YEAR ENDED 31ST DECEMBER, 1931.

(PART II).

PRICE : SHS. 5.

Published by Command of His Excellency the Governor.



ENTEBBE:

PRINTED BY THE GOVERNMENT PRINTER, UGANDA.

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CONTENTS.

	PAGE.
Report on Serere Experiment Station and Experimental Work in the Eastern Province	3—18
Report on Bukalasa Experiment Station	19—23
Report of the Cotton Breeding Section	24—42
Report of the Entomologist	43—58
Report of the Mycologist	59—60
Field Experiment on Blackarm Disease of Cotton	61—62
Report of the Agricultural Chemist	62—67
Report of the Economic Botanist	68—71
Report on the Government Plantation, Kampala	72—75
Report on the Botanic Gardens, Entebbe	76—77
Agricultural Circulars	78

ANNUAL REPORT ON SERERE EXPERIMENT STATION

AND

EXPERIMENTAL WORK IN THE EASTERN PROVINCE, 1931—32.

The work of the year can be conveniently described under four heads:—

SECTION 1.—SERERE EXPERIMENT STATION.

SECTION 2.—NGETTA FARM AND SUBSIDIARY EXPERIMENT FARMS.

SECTION 3.—DISTRICT EXPERIMENTAL WORK.

SECTION 4.—BUGUSEGE COFFEE PLANTATION.

The work done on different crops is summarised at the end of this Report.

SECTION 1.

SERERE EXPERIMENT STATION.

The organisation of work at Serere followed that of previous years thus:—

A. Experiment Farm.—Three 10-acre blocks make provision for plot experiments with cotton, groundnuts, sim-sim and maize in rotation with green manures. There are three one-acre plots known as the "breeding plots" for selection work on the same crops, and two permanent experiments—the Rotation Experiment and the Erosion Experiment.

B. Seed Farm.—This now comprises 85 acres. Its chief functions are to provide cotton seed for the Mulondo segregated area from new or re-selected strains destined for general cultivation, to increase seed supplies of mass selections from other crops, to maintain seed stocks of minor crops and to provide food for pupils attending the Agricultural School, while cost accounts are kept of all the crops grown.

C. Isolation Plots.—There was one extra $\frac{1}{4}$ -acre isolation plot added to the three pairs normally in use for running up new strains from the breeding plots. Two 2-acre increase plots form the link between the $\frac{1}{4}$ -acres and the Seed Farm.

D. School Gardens.—A small area is occupied by school gardens for the use of the Education Section.

BUILDINGS.

An extension to the office was built by the Public Works Department, thus providing a room for the use of the Agricultural Officer for Teso.

The Drilling Section bored two water holes, one near the Seed Farm and one at the top of the hill, and a good water supply should be assured when the pumps have been put in.

Three headmen's houses and a dining-room for pupils were erected under the supervision of the Serere staff.

METEOROLOGICAL CONDITIONS.

The Serere rainfall was 53.66 inches for the year and this figure was about three-quarters of an inch below the average. An abnormal feature of the weather was the drought of October. During that month the rainfall was 1.34 inches, the lowest recorded at Serere and 3.78 inches below normal. The previous four months had shown an increase on average rainfall, cool weather and absence of sunshine. On the whole the weather was not very favourable for most crops and very unfavourable for cotton after its early stages.

A. Experimental Work.

COTTON SPACING EXPERIMENT.

Objects.—This experiment was designed to test the two spacings 4 ft. by $1\frac{1}{2}$ ft. and 3 ft. by 1 ft., and also to find out how many seeds it is necessary to plant in order to obtain a full stand, at each spacing, without replanting the gaps.

Lay-out.—The two spacings 4 ft. by $1\frac{1}{2}$ ft., and 3 ft. by 1 ft., were each planted using three, six, nine, and twelve seeds per hole. Previous work has shown that there is a great difference in the yield of cotton when planted before or after the end of June. It was therefore decided to use two sowing dates, June 16th and July 15th. There were thus sixteen treatments, and these were replicated nine times in randomised blocks, making 144 plots in all. Each plot at picking time consisted of cotton grown on 24 ft. by 39 ft. of land. Outside this area each plot had its outside rows and outside plants. Before the first picking all the bolls and flowers on these outside rows and plants were picked off. Stand counts were made one week after singling and again in November.

Results.—The weather at both planting dates, and in fact throughout the planting season, was exceptionally favourable and the stand, after singling, for the whole experiment was 91.2 per cent. The second stand count gave the results shown below.

TABLE I.

MEAN PERCENTAGE BLANKS PER PLOT.									
Spacing.	3 ft. by 1 ft.				4 ft. by 1½ ft.				Mean % for Sowing Dates.
Seeds per hole ...	3	6	9	12	...	3	6	9	12
June sown ...	16.3	11.2	12.2	10.0	...	16.2	6.9	6.7	9.2
July „ ...	16.4	13.0	9.3	12.2	...	19.0	13.6	8.4	7.8
Mean % for spacings	...	12.6 %	...	...	...	10.97 %	...	...	...
Mean % for seeds per hole	...	...	Three seeds	...	...	...	17.00 % blanks.	...	...
	...	...	Six „	...	...	...	11.17 „	...	...
	...	...	Nine „	...	...	...	9.17 „	...	...
	...	...	Twelve „	...	...	...	9.81 „	...	...

The difference between means for sowing dates is not significant, but in the combined spacings and combined seeds per hole means, differences of 1.37 and 1.94 respectively are significant. Therefore in this experiment:—

1. *Seeds per hole.*—

Three seeds gave a worse stand than all others.
Six seeds were better than three seeds.
Nine seeds were better than three and six seeds.
Twelve seeds were better than three only.

2. *Spacings.*—

4 ft. by 1½ ft. spacing gave a better percentage stand than 3 ft. by 1 ft.

TABLE II.

MEAN YIELDS OF SEED COTTON IN LBS.									
Spacing.	3 ft. by 1 ft.				4 ft. by 1½ ft.				Mean % yields for Sowing Dates.
Seeds per hole ...	3	6	9	12	...	3	6	9	12
June sown ...	5.60	6.14	4.70	6.10	...	4.41	5.91	5.0	5.26
July „ ...	3.59	3.91	4.20	3.60	...	3.06	3.10	3.14	3.15
Mean % yields of spacing plots	...	4.73	...	...	...	4.26	...	...	...

Mean % yields of combined sowing date and spacing plots:—

June	...	3 ft. by 1 ft.	...	5.64
June	...	4 „ by 1½ „	...	5.42
July	...	3 „ by 1 „	...	3.83
July	...	4 „ by 1½ „	...	3.11

Although the experiment satisfies the Z test none of the differences due to the number of seeds planted, or the spacing used, are large enough to be significant. The superiority of June cotton over July cotton is again shown.

In common with the cotton in Teso district the yield in this experiment was very low, being only 209¼ lbs. per acre, and the percentage of stained cotton was high, the average per plot being 30.7 per cent.

The figures showed an apparently greater percentage of stained cotton with close planting in the June plots, but this was the reverse with the July cotton, where the 4 ft. by 1½ ft. spacing had the greater proportion of fiff.

TABLE III.

					Percentage Stained Cotton.	
June	...	3 ft. 1 ft.	...	...	31.8	30.2
„	...	4 „ 1½ „	...	...	28.6	
July	...	3 „ 1 „	...	...	30.5	31.2
„	...	4 „ 1½ „	...	...	31.8	

The calculation of this part of the experiment did not satisfy the Z test owing to the very great variation in the quantity of stained cotton as between plots. The range was 10% to 61%. With such a variation an answer to the question will probably not be obtained before some years' repetition of the experiment.

Previous Work.—Spacing trials at Serere since 1925 have given the following results.

TABLE IV.

					Yield of 3 ft. by 1 ft. plots expressed as percentage of 4 ft. by 1½ ft.	
Spacing.						
1925	...	4 ft. by 1½ ft. and 3 ft. by 1 ft.	...	...	103.6	
1926	...	4 „ 2 „ „ „	...	...	125.6	
1927	...	4 „ 2 „ „ „	...	...	112.3	
1928	...	4 „ 2 „ „ „	...	...	96.9	
1929	...	4 „ 1½ „ „ „	...	...	116.6	
1930	...	4 „ 1½ „ „ „	...	...	98.6	
1931	...	4 „ 1½ „ „ „	...	...	113.0	

Conclusions.—In the experiment under discussion cotton spaced at 3 ft. by 1 ft. gave a higher yield than that spaced at 4 ft. by 1½ ft. for the fifth time out of seven trials conducted at Serere.

As regards the number of seeds planted per hole, even under excellent planting conditions three seeds per hole gave a worse stand than six, nine, or twelve. In this experiment no advantage was gained by planting twelve seeds and it would appear that nine seeds give the best stand. In this experiment the number of seeds planted did not affect the yield. There was no evidence to show that close planting affects the proportion of stained to clean cotton.

COTTON RATOONING EXPERIMENT.

Object.—To compare the yield of ratooned cotton with that of annual cotton and to make observations on the quality of the lint.

Lay-out.—The experiment was made up of the following treatments:—

- (a) Plants cut back to 6 inches.
- (b) Plants cut back to 18 inches.
- (c) Plants topped.
- (d) Control.

The lay-out was a Latin square of sixteen plots which were planted in August, 1930, the yields of cotton from all plots being recorded. The control plots were uprooted, and the other plots ratooned in April, 1931. The control plots were planted with a green manure until June, when cotton was re-sown. The plots measured 30 ft. by 32 ft., and there were 6 ft. lanes between them so that the control plots should not be over-shadowed by the ratooned cotton. The spacing was 3 ft. by 1 ft., in order that the stand should remain reasonably high in spite of the gradual reduction in numbers owing to the death of ratooned plants.

Results.—This experiment was intended to last for a number of years, after which the yields from each treatment were to be totalled and compared. If any of the ratooned treatments gave a greater yield than the total of the re-planted control, there would be something to be said for ratooning.

The first year's average yield was 6.9 lbs. per plot. The three ratoon treatments yielded, in the second year, an average of 1.74 lbs. per plot and the control yielded 0.63 lbs. per plot.

The cause of these low yields can be put down to blackarm. The ratoon cotton was infected early in the season and lesions developed on the stems and leaf petioles before the control cotton was planted. The latter being close to heavily infected plants acquired the disease at a very young stage of growth, many of the plants died, and the rest remained stunted.

The following figures are of interest, though they should not be used to compare one treatment with another.

TABLE V.

		Control, June sown.		Topped.		Cut back at 18 ins.		Cut back at 6 ins.
Weight of 100 seeds in grams	...	7.30	...	7.15	...	6.15	...	6.43
Ginning %	...	30.60	...	31.20	...	31.10	...	31.10
Lint index	...	3.25	...	3.26	...	2.80	...	2.88
Lint length mm.	...	29.89	...	29.72	...	30.22	...	29.19

The lint index figures are abnormally low. They should be in the neighbourhood of 5.0 to 5.5 grams. The seed weight is also very low, the usual figure being about 10 grams. The Assistant Cotton Botanist reported that all the samples were weak and very wasty, with variable staple lengths. At the end of the second picking season the stand of the ratooned plots had become reduced to 41%.

Conclusions.—Although the ratooned cotton in this experiment apparently yielded more than the control this was due to a heavy infection of blackarm carried by the former. The yield from the ratooned cotton was very low. The lint was of poor quality. The conclusion reached is that ratooning of cotton is very undesirable. This experiment has now been discontinued.

GROUNDNUT SPACING AND CULTURAL TRIAL.

Object.—To find out the best spacing at which to grow the erect or bunch groundnut when in lines or on ridges or broadcast, and to discover whether anything is to be gained by ridging or line sowing as opposed to the native method of broadcasting. This experiment was done in 1930 and it was repeated in order to confirm, or otherwise, the results obtained.

Lay-out.—The four spacings 1 ft. by 1 ft.
1½ ft. by 1½ ft.
2 ft. by 1 ft.
3 ft. by 1 ft.

were each tried in lines, on ridges, and broadcast at an equivalent seed rate. These twelve treatments were repeated five times in randomised blocks, the sub-plots measuring 12 ft. by 135 ft. after the outside rows had been discarded. One resowing of blanks was allowed and the average weight of the seed used to re-sow the spaced plots was put into the gaps in the broadcast plots of the appropriate spacing. The first experiment was completely destroyed by locust hoppers. It was re-planted on May 4th and harvested on August 13th.

Results.—

TABLE VI.

Spacing.	Cultural Treatment.				Mean of Spacings.
	Lines.	Ridges.	Broadcast.		
1 ft. by 1 ft. ...	60.6	49.6	54.1	...	54.8
2 " " 1 " ...	39.2	33.2	37.1	...	36.5
1 ft. 6 in. by 1 ft. 6 in. ...	36.9	35.2	33.2	...	35.1
3 ft. by 1 ft. ...	27.1	29.9	33.8	...	30.3
MEAN OF CULTURAL TREATMENTS ...	41.0	36.9	39.5	...	39.2

This experiment is significant when $P=0.1$. The standard error of comparisons being 4.04, differences of 8.08 are real differences.

Conclusions.—The 1 ft. by 1 ft. spacing is superior to either 2 ft. by 1 ft., $1\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft., or 3 ft. by 1 ft. Except within the 1 ft. by 1 ft. treatment when the line sown plots were superior to those in rows, there is no significant difference between the three cultural methods. This experiment confirms the results obtained in 1930 and it can be concluded that 1 ft. by 1 ft. spacing is the best and that no advantage in yield is gained by planting groundnuts in lines or ridges.

ROSETTE DISEASE IN GROUNDNUTS.

During the growth of the experiment described above, a number of counts of plants affected with rosette disease was made with the object of discovering whether spacing had any effect on the incidence of the disease.

A stand count was made on June 24th and the results given below are expressed as percentages of the actual stand. These counts included the marginal rows.

TABLE VII.
PERCENTAGES OF PLANTS WITH ROSETTE DISEASE.

Date of Count.	Spacing in Line Sown Plots.			
	3 ft. by 1 ft.	2 ft. by 1 ft.	$1\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft.	1 ft. by 1 ft.
June 24th	5.7	6.1	4.0	3.4
July 13th	5.4	5.3	4.2	2.1
August 13th	49.9	49.4	44.4	25.5

It will be noticed that there was an apparent decline in the percentage of plants affected at the time of the second count but this was probably due to the disease being masked by the green colouration which often succeeds the first yellowing of the leaves.

The last count was made just before harvest and is interesting in that it shows that a good crop can be obtained even if a large proportion of the plants are attacked by rosette disease, provided that the infection is not during the early growth of the plant.

These counts favour the theory that wider spacings are apt to induce infections with rosette disease. If this is so then the outside rows, having a path on one side of them, and thus being at a very wide spacing might be expected to show a greater proportion of infected plants than those in the plots. In order to investigate this point the outside rows were examined separately at the last count.

TABLE VIII.
ROSETTE COUNT OF AUGUST 13TH WITH OUTSIDE ROWS SEPARATED.

	Spacing.			
	3 ft. by 1 ft.	2 ft. by 1 ft.	$1\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft.	1 ft. by 1 ft.
Percentage in plots ...	52.4	45.1	39.9	24.0
Percentage in outside rows ...	44.9	62.3	63.4	35.3

Except in the 3 ft. by 1 ft. plots there were more rosetted plants in the outside rows than in the plots.

The difference of 28.4 shown between rosette incidence in the 3 ft. by 1 ft., and 1 ft. by 1 ft. spacings within the plot is statistically significant when $P=0.05$.

Conclusion.—There is not enough evidence to conclude, but there are some indications, that groundnuts when closely spaced are less liable to rosette disease than when wide spacings are used.

The question of rosette disease is of considerable importance and the subject is to be investigated further by testing the effect of very close spacings, mulching, and roguing, in the coming year.

GROUNDNUT VARIETY TRIAL.

Objects.—(a) To test a variety of bunch groundnut obtained from the Department of Agriculture, Tanganyika, against the Serere variety. (b) To test the yield of bunch groundnuts against the spreading groundnut. (c) To test mass selections of both types of groundnuts against the ordinary crop.

Lay-out.—The bunch groundnuts were all planted at 1 ft. by 1 ft., for comparison with spreading groundnuts at 2 ft. by 1 ft., but as it is not certain whether the latter is the best spacing another treatment was included at $1\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft., making six treatments. These were repeated in five randomised blocks, each sub-plot being 12 ft. by 135 ft. after removing the two marginal rows.

Results.—

TABLE IX.
MEAN YIELDS OF GROUNDNUTS IN LBS. (UNSHELLED).

Variety.	Spacing.				Yield.
	1 ft. by 1 ft.	2 ft. by 1 ft.	$1\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft.	1 ft. by 1 ft.	
Tanganyika Bunch	...	...	...	...	64.4
Serere Bunch	...	...	...	...	60.3
Mass Selected Serere Bunch	...	...	...	...	62.4
Spreading	...	...	...	...	32.4
Spreading	...	...	...	...	31.6
Mass Selected Spreading	...	...	...	...	36.3

This experiment satisfies the Z test when $P = .01$. Differences of 7.59 are significant. Thus all bunch varieties were better than all spreading varieties. There is no significant difference between the mass selected and ordinary varieties or between the two spacings used for the spreading groundnut, or between the Tanganyika variety and the local bunch groundnuts.

Conclusions.—The imported Tanganyika bunch shows no advantage over the Serere stock and in fact appears to be the same kind of groundnut. The bunch type seems to be more suitable for cultivation at Serere than the spreading type, the advantage being nearly 100%. It is possible, however, that this difference would not be so great if close spacing had been used in both cases. This point will be investigated in the 1932 experiments.

The results of the mass selected varieties though failing to show any great advance in yield are not unfavourable, so that mass selection can be continued on the same lines as before.

SIM-SIM SOWING DATE AND SEED RATE TRIAL.

Object.—To find the best date for sowing sim-sim and the best seed rate, in confirmation or otherwise, of the experiment of 1930.

Lay-out.—There were four seed rates and four dates:—

March 19th	at	2½ lbs.,	5 lbs.,	7½ lbs.	and	10 lbs.	per acre.
April 2nd	"	"	"	"	"	"	"
April 16th	"	"	"	"	"	"	"
April 30th	"	"	"	"	"	"	"

These sixteen combined treatments were laid down in nine randomised blocks, the sub-plots being 12 ft. by 135 ft. Twelve feet is the width of the seed barrow with which the plots were sown.

Results.—Very little notice can be taken of the results owing to the failure of the crop due to mildew, *Cercospora*, gall midge, and forms of witches broom.

The mean yields for sowing dates were:—

March 19th	...	...	...	...	...	6.14 lbs.
April 2nd	...	...	...	...	...	3.24 lbs.
April 16th	...	...	...	...	...	1.06 lbs.
April 30th	...	...	...	...	...	failed.

Within the March 19th plots those sown at 10 lbs. and 7½ lbs. per acre gave higher yields than the 2½ lbs. seed rate.

Conclusions.—The yield of the earliest sowing being about 163 lbs. per acre is of the same order as those of the 1930 experiment and to that extent confirms the conclusions reached then that the earlier the sowing date and the heavier the seed rate up to 10 lbs. per acre, the better.

SIM-SIM VARIETY TRIAL.

Owing to the low yields of sim-sim which are usual at Serere it was decided to test seed bought locally in comparison with mass selected and ordinary seed from the farm. These three varieties were put down in strips 12 ft. by 135 ft., repeated eight times. The seed rate was 10 lbs. per acre. The plots were sown on April 18th, but after a satisfactory germination, were attacked by various diseases and gave a crop so small that the yields were not worth recording.

MAIZE EXPERIMENTS.

Owing to the frequent attacks of locusts throughout the year it was decided not to repeat the Maize Spacing Trial for autumn planting but to substitute mtama (Sorghum) which is less attractive to locusts than maize.

MTAMA (SORGHUM) SEED RATE TRIAL AT TWO DATES.

Objects.—To find the best seed rate for mtama and the better of two dates for sowing it in the latter part of the year.

Lay-out.—There were five seed rates which were sown thus:—

September 4th	at	6 lbs.,	12 lbs.,	16 lbs.,	20 lbs.	and	24 lbs.	per acre.
October 1st	"	"	"	"	"	"	"	"

Each treatment was repeated ten times in randomised blocks making 100 plots in all. Each plot was 12 ft. by 135 ft. The seed was sown with the seed barrow.

Results.—Germination was very satisfactory but the October plots had very dry weather in the young stages of growth. Locusts appeared on several occasions but did little damage.

TABLE X.

MEAN YIELDS OF MTAMA IN LBS. GRAIN.

Seed Rate.	Sowing Date.					
	September 4th			October 1st		
6 lbs.	...	...	...	55.11	...	21.19
12 "	...	...	...	55.64	...	27.62
16 "	...	...	...	58.67	...	33.92
20 "	...	...	...	52.79	...	28.26
24 "	...	...	...	53.07	...	31.74
MEAN	...	...	...	55.05	...	28.54

The experiment is significant when $P = .01$. Differences of 5.16 are significant differences so that all September 4th plots are better than all October 1st plots. Within the first sowing date 16 lbs. seed rate is better than 20 lbs. and 24 lbs. Within the second sowing date 16 lbs. seed rate is better than 12 lbs. and 20 lbs. and all rates are better than 6 lbs. per acre.

Conclusions.—The seed rate of 16 lbs. per acre for mtama is the best and sowing should be done in September.

PERMANENT ROTATION EXPERIMENT.

This experiment consists of the standard rotation and three variations of it:—

A.	B.	C.	D.
Cotton.	Cotton.	Cotton.	Cotton.
Bulo.	Groundnuts.	Green manure.	Sim-sim.
Cotton.	Cotton.	Cotton.	Cotton.
Groundnuts.	Bulo.	Sim-sim.	Groundnuts.
Sim-sim.	Green manure.	Groundnuts.	Bulo.
Green manure.	Sim-sim.	Bulo.	Green manure.

Each rotation needs three plots, and with five repetitions there are sixty $1/40$ acre plots in a random scatter.

The third year's results are disappointing. The grain crop was finally destroyed by flying locusts after several re-sowings had been made due to the attacks of hoppers. The sim-sim failed, in common with all the sim-sim on the farm, and the cotton yielded poorly due to a severe infection of blackarm which spread in from the cotton on the adjacent ratooning experiment. The groundnuts yielded well in the rotations in which they were planted in the spring.

The results from this experiment will not be given until after the fifth year when the yields from the four rotations will be compared.

EROSION EXPERIMENT.

The cropping of the Erosion Experiment, being groundnuts followed by maize, was according to the rotation laid down.

The experiment is designed to test the effect of checking erosion on the yields of the crops obtained and on the composition of the soil, in strips 100 yards long treated as below.

- A.—Control, where no steps are taken to check erosion.
- B.—Cajanus hedge at 100 ft. intervals across the slope.
- C.—Lemon grass hedge at 100 ft. intervals across the slope.
- D.—Surface drain at 100 ft. intervals, at a slight angle to the slope and leading into the side drains between the plots.

This experiment was begun in 1930. The yield records and soil samples are sent to the Agricultural Chemist who is responsible for the design of the experiment.

COTTON SELECTION.

The work carried out by the Assistant Cotton Botanist in cotton selection, laboratory examination, variety trials and experiments in connection with blackarm is described in the Cotton Botanist's report.

B. Work Done on the Seed Farm.

The Seed Farm comprises 80 acres of land in 10-acre blocks, 60 acres of which are under rotation, 10 acres are used for maintenance of stocks of minor crops, and 10 acres are under tree crops.

Owing to the ten per cent. reduction in the funds which had been granted early in the year for the maintenance of work at Serere, economies had to be effected and these were chiefly made on the Seed Farm. In consequence the rotation given in the Annual Report for 1930 was modified so as to give:—

- 30 acres green manure followed by 30 acres cotton.
- 10 acres groundnuts followed by 10 acres green manure.
- 10 acres bulo followed by 10 acres green manure.
- 10 acres under *Crotalaria striata* the whole year.

A small area of maize was grown on the seed maintenance block. No sim-sim was grown on the Seed Farm.

Five acres which had partly been under cultivation previously were ploughed up for oil palm cultivation, thus bringing the acreage up to 85 acres.

COTTON.

The rotation normally allows for two-thirds of the cotton crop to be planted early, but owing to the absence of a maize crop it was possible to put the whole 30 acres in early. The green manures used in the three blocks were bulo, cajanus, and soya beans respectively. The results of spacing experiments carried out at Serere in previous years having shown the superiority of 3 ft. by 1 ft. spacing over 4 ft. by $1\frac{1}{2}$ ft., which has up to now been the standard practice, the former spacing was used with three seeds per hole.

The variety was S.G. 29, the Serere selection which is being introduced into general cultivation *via* Mulondo. In common with the general crop in Teso, cotton, in spite of an excellent start, did not yield well. It was chiefly affected by the attacks of *Lygus* followed by

very dry weather in October which caused much shedding of the small number of bolls which had set. The yields were:—

				Lbs. per acre.
Block 3 (planted June 26th—30th)	...	...	...	296
Block 5 (planted July 2nd—3rd)	...	...	...	240
Block 8 (planted June 19th—24th)	...	...	...	442

The total 9,780 lbs. of cotton should provide enough seed for Mulondo.

GROUNDNUTS.

Costings of Groundnut Cultivation.—Broadcasting, line sowing, and planting on ridges have been tested as cultural methods for groundnuts for several years. Although tried with various spacings, very little difference, and no statistically significant differences, have been found in the yields of plots grown under these three treatments. It was thought possible, however, that there might be a saving of labour, especially at harvest time, if line sowing were adopted, and at the same time it was thought desirable to find the cost of ploughing out, digging out with a three-pronged fork (Lumbugu fork), and digging out with the ordinary native hoe.

Eight separate acres, four of bunch and four of spreading groundnuts, were treated as follows:—

1. Broadcast at seed rate equal to 1 ft. by 1 ft. spacing and harvested with native hoes.
2. Spaced at 1 ft. by 1 ft., and harvested with native hoes.
3. Spaced at 1 ft. by 1 ft., and harvested with lumbugu forks.
4. Spaced at 2 ft. by 1 ft., and harvested by ploughing out.

Results.—Differences in labour expended can be divided into two parts:—

- (a) Cultivation, which can be expressed per acre.
- (b) Harvesting, which should be expressed per lb.

Owing to differences in yield between the acre plots the labour observed to be expended in harvesting per 100 lbs. has been converted to labour per acre by a calculation assuming that all acres yielded at the same rate. The rates adopted were the average yield of the four acres of bunch, and the four acres of spreading, respectively, 1,675 lbs. and 874 lbs. per acre.

An acre of 1 ft. by 1 ft. bunch groundnuts grown on another block was included afterwards in order to compare the cost of ploughing out at that spacing with the cost of ploughing out at 2 ft. by 1 ft. The results are given in Table XI.

TABLE XI.

LABOUR, IN HOURS PER ACRE, EMPLOYED IN CULTIVATING AND HARVESTING GROUNDNUTS.

1. BUNCH GROUNDNUTS.

Spacing.	Method of cultivation.	Planting and covering.	Filling blanks.	Weeding twice.	Total C.	Method of harvesting.	Digging out.	Collecting nuts.	Total H.	Cultivation + Harvesting Hrs.	TOTAL: Man-days.
1 ft. by 1 ft....	Broadcast...	68	15	134	217	Native hoes ...	27	256	283	500	62.5
1 " " 1 "...	Lines ...	132	43	133	308	Lumbugu forks 69		288	357	665	83.1
2 " " 1 "...	Lines ...	57	20	122	199	Ploughed out... 35		220	255	454	56.7
1 " " 1 "...	Lines ...	132	43	133	308	Native hoes ... 27		281	308	616	77.0
1 " " 1 "...	Lines ...	132	43	133	308	Ploughed out... 81		281	362	670	83.7

2. SPREADING GROUNDNUTS.

2 ft. by 1 ft....	Broadcast...	31	10	83	147	Native hoes ... 16		634	650	797	99.6
2 " " 1 "...	Lines ...	53	37	113	203	Lumbugu forks 12		701	713	916	114.5
2 " " 1 "...	Lines ...	53	37	113	203	Ploughed out 34		559	593	796	99.5
2 " " 1 "...	Lines ...	53	37	113	203	Native hoes ... 23		722	745	948	118.5

CONCLUSIONS.

With the Bunch Groundnut.—Ploughing out at 2 ft. by 1 ft. spacing is the cheapest; but the Serere spacing trials showed reductions of 11% and 33%, in 1930 and 1931, in the yield of groundnuts when planted at this spacing instead of 1 ft. by 1 ft., so that the reduction in cost does not compensate for the loss of crop. Harvesting with native hoes at the 1 ft. by 1 ft. spacing is cheaper than any other method, and owing to the saving in labour for planting, the broadcast plot is cheaper than the lined plots at this spacing.

With the Spreading Groundnut.—Ploughing out is cheaper than harvesting with native hoes, but when the groundnuts are broadcast the saving of labour on planting and weeding reduces the total man-days to the same figure. Lumbugu forks were not successful in reducing the labour at harvesting. Comparing the two types of groundnut the bunch groundnut yielded nearly twice as much as the spreading groundnut, while the latter required 40—50% more labour for its cultivation and harvesting. The native method of growing groundnuts is to sow them broadcast and to harvest them with the hoe. There is nothing in the results of this costings experiment to indicate that his methods are not the best.

BULO (ELEUSINE).

Ten acres were sown with the seed barrow at the rate of 10 lbs. per acre on March 6th. Of this, half-an-acre was devoted to ten strips of different bulo varieties sown for observation and selection for early maturity.

The first sowing was eaten off by locust hoppers. Re-sowing was done on April 8th. This was eaten off by hoppers on April 26th. The re-sown crop of May 4th did well until it was destroyed by adult locusts on July 26th.

MAIZE.

Two-and-a-half acres of Hickory King which had been mass selected for high yield and sturdy growth, by rejecting all plants bearing their cobs higher than the seventh node, were destroyed by locusts. In spite of re-sowing, only 130 lbs. of seed were harvested, most of which was of poor quality. No result at all was obtained from the varieties Muratha and Flat White which were grown in increase plots. Only $7\frac{1}{2}$ lbs. of seed were harvested from a quarter-acre of the White Congo variety.

A variety new to Serere under the name of Wisconsin produced 103 lbs. of seed from a plot containing about seven hundred plants. It is said to be an early maturing variety. This point could not be observed owing to the attacks of locusts.

OIL PALM.

A new block of five acres on good deep soil was opened for oil palm cultivation. The young plants were sent up from the Botanic Gardens, Entebbe. They were planted at 28 ft. by 28 ft. spacing and have become fairly well established. Setts of *Centrosema pubescens* were planted between the rows and this has formed an effective cover.

SHEA NUTS.

The Shea butter tree (*Butyrospermum parkii*) is a common tree in Teso district, and it was decided to plant $7\frac{1}{2}$ acres of otherwise useless land on Block I with this tree for observations as to its value as an oil producing crop. Two spacings are being used, 50 ft. by 50 ft. and 30 ft. by 12 ft. 6 ins., so that if the latter is found to be too close, alternate trees may be cut out.

It appears that only fresh seed can be expected to germinate. The seedlings send down a tap root fully six inches long before the plumule develops. Seedling plants bearing four or five leaves have a tap root 1 ft. 6 ins. deep. It is therefore advisable to plant at stake or else to use seedlings before anything has appeared above ground.

MISCELLANEOUS CROPS.

Small plots of the following crops were grown for stock purposes:—Soya beans, gram, *Centrosema pubescens*, *Crotalaria alata*, buckwheat, sword beans, *Dolichos lablab*, *Cajanus indicus*, and sann hemp.

GREEN MANURES.

The following green manures were used during the year:—*Cajanus indicus* sown at 50 lbs. per acre again made an excellent cover and green manure before cotton. It is not, however, immune from attack by locusts, although the crop made a good recovery after being partly eaten.

Dolichos lablab was not so successful as usual, being attacked by a disease which produced a curling and rusty appearance of the leaves and scabs on the stems.

The seed stock plot was a failure from this cause and the green manured plot was not well covered.

Sword Beans again produced a satisfactory cover and a good bulk of material for ploughing in on ten acres of the Seed Farm. It was sown in August and ploughed in November.

Crotalaria striata was used on one 10-acre block, being allowed to grow the whole year. The bushes were then cut down in time to allow of a sowing of bulo to be used as an early green manure in 1932.

Bulo (*Eleusine coracana*).—This was again used before cotton. Locusts ate it off before it had reached the right stage for ploughing in.

Crotalaria juncea sown in the autumn proved to be a very satisfactory green manure. The seed rate was 70 lbs. per acre. It was noticeable on a small plot planted in the school gardens that it can survive a dry season, and this is a great advantage at Serere.

Crotalaria alata.—This was tried for the first time. It neither covered the ground nor produced a sufficient bulk of material to make either a cover crop or a green manure. Seed rates of 12 lbs., 16 lbs., 20 lbs., and 40 lbs. per acre were tried.

Soya Beans.—This makes a good cover if the rains are satisfactory, as was the case this year, when sown at the rate of 50 lbs. seed per acre.

NURSERY AND ORCHARD.

The Plantation Manager reports that 461 young fruit trees were distributed. The varieties most in demand were oranges and mangoes, but a number of guavas, soursofs, limes and other fruits were sent out. There were also 85 young trees comprising *Albizia*, *Poinciana*, *Grevillia*, *Eucalyptus*, etc., issued from the nursery. The Forest Department took 500 lbs. of mango seed, and a quantity of sisal setts went to the Agricultural Officer, Busoga.

Hydnocarpus Wightiana.—The first fruit from a seven-year-old tree ripened in October, and this tree is now bearing a considerable crop. Bael Fruit (*Aegle marathos*).—One fruit has been obtained from a tree received as a seedling nine years ago. Tung Oil (*Aleurites fordii*).—It is proposed to utilise some rough land for a plantation of this tree and the seedlings are being raised in the nursery.

EROSION.

The angle system of surface drains described in last year's Annual Report has been given up. It adds considerably to the cost of planting such crops as cotton and groundnuts sown in lines and was not found to be very effective in stopping erosion. Open furrows at a distance of 15 yards to 20 yards apart running parallel to the long side of each field gave satisfactory results in holding up surface wash.

The autumn green manuring is so arranged that the green manure is ploughed in while the soil is still moist enough for the plough to do its work. A light seeding of bulo is then thrown in and this will germinate and grow sufficiently to hold the soil when the rains break after the dry season, provided that open furrows are left as described above.

SANN HEMP TRIALS.

A report was prepared on the cultivation and retting of sann hemp based on work done at Serere during the year, and twenty-six samples of fibre ranging from 1½ lbs. to 24 lbs. in weight were sent to England for examination.

Seed Rates of 40 lbs., 50 lbs., 60 lbs., and 90 lbs. per acre were tried. Cuttings were made at 55 days, 108 days, and 140 days with sann hemp of the first three seed rates, and two more at 157 and 164 days with sann hemp from the 90 lbs. plot. This latter did very much the best of the four but this may have been due partly to its being on better land. However, the height of the plants on this 90 lbs. seed rate plot was well over 7 ft. as against 4 ft. 3 ins. to 5 ft. 2 ins. obtained from the smaller seed rates.

Retting Periods of three days, five days and seven days were first tried but the later cuts were done with three and three-and-a-half day immersion periods. Stripping off the fibre was done (a) immediately after taking out of the water, (b) up to three days after taking out of the water.

Yields.—The results in the tables shown below were calculated from the average of three areas of the order of 150 sq. yds. The fibre weights were calculated from three or four bundles of sun dried material producing two to three pounds of fibre, so that when expressed as pounds per acre there must be a considerable probable error. The first cut at 55 days gave very little fibre. The results of the next cut are given below.

TABLE XII.

YIELDS OF SANN HEMP OF 108 DAYS GROWTH IN LBS. PER ACRE.

<i>Seed Rate.</i>				<i>Green Material.</i>				<i>Sun-dried Material.</i>
40 lbs.	...	...	...	9,321	...	...	...	4,639
50 "	...	...	...	12,264	...	...	...	5,767
60 "	...	...	...	13,032	...	...	...	5,948

TABLE XIII.

YIELD OF FIBRE IN LBS. PER ACRE.

Seed Rate.	Three-day Retting.			Five-day Retting.			Seven-day Retting.	
	Stripped Wet.		3rd day.	Stripped Wet.		3rd day.	Stripped Wet.	
40 lbs. ...	111	...	137	...	174	...	159	...
50 " ...	156	...	212	...	192	...	260	...
60 " ...	217	...	251	...	223	...	266	...

In these results it can be seen that the yield of green material and the yield of fibre increased with the seed rate.

Slightly more fibre was produced by retting five days than by three days. The fibre was lighter in colour and there was a suspicion of wastiness. Seven days immersion reduced the yield of fibre which was wasty and weak. The loss of weight was partly due to the breaking of the fibre when being stripped off the stems. When stripping was not done for three days after taking the bundles out of the water there appeared to be an increase in fibre yield. However, the fibre was much darker in colour and the extra weight might have been due to impurities which are more difficult to wash out than when stripping is done at once.

The 140 day cut, by which time the plants had reached maturity, produced little increase in yield. In this case five days retting was too long.

TABLE XIV.

SANN HEMP OF 140 DAYS GROWTH.

<i>Seed Rate.</i>				<i>Yield of Fibre after Retting.</i>	
				<i>Three Days.</i>	<i>Five Days.</i>
40 lbs.	...	...	...	207	177
50 "	...	...	...	196	190
60 "	...	...	...	243	206

The 90 lbs. seed rate plot grew very strongly and for a longer period, and yielded much better than the smaller seed rates. Results are given below.

TABLE XV.

YIELDS OF SANN HEMP IN LBS. PER ACRE.

<i>Seed Rate.</i>	<i>Green Material.</i>	<i>Sun-dried Material.</i>	<i>Fibre from Retting.</i>			<i>Growing period.</i>
			<i>3 days.</i>	<i>3½ days.</i>		
90 lbs.	19,090	7,540	—	288	...	140 days.
	13,175	6,448	417	418	...	157 "
	15,810	7,080	—	476	...	164 "

In these results it can be seen that the longer growing period gave higher yields of fibre and that short retting periods are satisfactory. The last retting was made from plants which had been allowed to dry in the field for only a short time before retting as it was suspected that the longer the drying period the darker was the fibre produced. This was borne out by the bright appearance of the sample obtained. It was also found that a slightly longer period than three days immersion produced a lighter colour in the fibre.

The length of the fibre was 6 ft. as against 4 ft. 6 ins. from the smaller seed rates. The cost of retting was high. It was found that a labourer only stripped 2 lbs. of fibre per day. This could probably be bettered with practice but even so the process would be too slow to enable the cultivator to deal with anything but a small plot.

The yields obtained were low and not up to the quantity which can be obtained in India. The length and strength of the fibre were satisfactory. Until the samples sent home have been reported on it would be unwise to draw conclusions but it would appear that:—

- (a) For yield and long fibre a seed rate of 90 lbs. or more is required.
- (b) A retting period of three to three-and-a-half days is sufficient.

ANT HILLS.

An attempt was made to remove ant hills on the seed farm by blasting with gelignite. These ant hills are 7—10 feet high, about 12—14 feet across the base of the dome and up to 40 feet in diameter measured from the beginning of the rise from ground level. Where they have been partly levelled this base is even wider. The method used was that described in a publication from the Gold Coast. A ring of holes three feet deep was made with crowbars round the base of the ant hill dome and one hole was put down the centre. On the larger hills a second ring of holes was made lower down. In each hole six or eight sticks of gelignite were put in and the centre hole had up to twelve sticks. The explosion of these charges did not produce satisfactory results. In every case the dome of the ant hill was shattered but not removed. Even if the centre had been successfully blown out it was doubtful if the crater could have been made big enough to accommodate the soil sloping out to a width of forty feet.

SECTION 2.

NGETTA FARM AND SUBSIDIARY EXPERIMENT FARMS.

NGETTA FARM.

This farm is maintained out of a grant voted from Lango Native Administration funds.

The area now extends to 50 acres. The main functions of the farm are:—

1. To duplicate or vary some of the Serere experiments.
2. To investigate the cultivation of food crops.
3. To record the man-days employed for the cultivation of native crops.

The year under review was a bad one for cotton in Lango and the yields obtained at Ngetta were low. Locusts destroyed the grain crops and the kapenda (*Cajanus*), thus bringing to nought observations on bulo varieties, and work on the seed rate and cultivation methods for kapenda. A test of the relative cost of growing the two types of groundnuts was also spoiled by locusts eating off the bunch type. This work will be repeated.

COTTON SOWING DATE AND SPACING TRIAL.

Object.—To find the better of the two spacings 3 ft. by 1 ft. and 4 ft. by 1½ ft. and to observe the yield of cotton planted at fortnightly intervals from May 29th until August 7th.

Lay-out.—The arrangement of the twelve treatments in ten randomised blocks, the sub-plots being 24 ft. by 37 ft. at picking time was similar to the experiment carried out at Serere and described in the Annual Report for 1930.

Results.—The yields from this experiment were disappointing. The cotton started well but rainy weather caused it to go to wood and there was much shedding due to *Lygus*, but the cause chiefly contributing to the poor yield was damage by white ants. The 4 ft. by 1½ ft. spacing gave a stand of 81.6% but 3 ft. by 1 ft. gave only 53.6% stand.

TABLE XVI.

MEAN YIELD OF SEED COTTON IN OUNCES.

Date.			4 ft. by 1½ ft.		3 ft. by 1 ft.		Mean.
May 29th ...	...	...	77.1	...	109.9	...	93.5
June 12th ...	...	...	42.5	...	62.8	...	52.6
June 26th ...	...	...	27.3	...	41.9	...	34.6
July 10th ...	...	...	28.8	...	44.1	...	36.4
July 24th ...	...	...	20.4	...	22.0	...	21.2
August 7th ...	...	...	8.7	...	11.3	...	10.0
			34.1	...	48.7		

The variance due to treatment is significant when $P = .05$ and a difference of 14.4 between observations within spacings or sowing dates is a significant difference. These results show that the sowing dates May 29th and June 12th are significantly better than all the rest and August 7th is significantly worse than all except July 24th. 3 ft. by 1 ft. spacing is better than 4 ft. by 1½ ft. at all dates except the last two where the yields are so small as to be of no account.

Conclusions.—It is not very satisfactory to draw conclusions from experiments with cotton where the mean yields are as low as 120 lbs. per acre, but the results such as they are bear out the conclusions reached from previous work, which shows that early planting gives a higher yield than late planting, and that a closer spacing than that obtained by planting at 4 ft. by 1½ ft. will increase the yield.

GROUNDNUT SPACING AND BROADCAST TRIAL.

Object.—To find the best spacing for spreading groundnuts and to determine whether any advantage is gained by sowing in lines, over broadcasting, and to observe the effect of ridging.

Lay-out.—Spacings 1 ft. by 1 ft., 2 ft. by 1 ft., and 3 ft. by 1 ft. sown in lines.

1 ft. by 1 ft., 2 ft. by 1 ft., and 3 ft. by 1 ft. broadcast at an equivalent seed rate.

2 ft. by 1 ft. on ridges.

These seven treatments were replicated five times in randomised blocks. The size of the plots harvested was 12 ft. by 135 ft.

Results.—

TABLE XVII.

MEAN YIELDS OF GROUNDNUTS IN LBS. (UNSHELLED).

			1 ft. by 1 ft.		2 ft. by 1 ft.		3 ft. by 1 ft.
In lines	...	...	59.4	...	53.2	...	49.0
Broadcast	...	...	62.2	...	41.4	...	36.8
Ridged	...	...	—	...	51.0	...	—
			60.8	...	47.3	...	42.9

Differences of 13.2 are significant in this experiment so that:—

1 ft. by 1 ft. broadcast is better than 2 ft. by 1 ft., 3 ft. by 1 ft. broadcast and 3 ft. by 1 ft. in lines.

1 ft. by 1 ft. in lines is better than 2 ft. by 1 ft. and 3 ft. by 1 ft. broadcast.

3 ft. by 1 ft. broadcast is worse than all others except 2 ft. by 1 ft. broadcast and 3 ft. by 1 ft. in lines.

There is no significance in the differences between the lined, broadcast, and ridged plots.

Conclusions.—Previous work at Ngetta has shown that 2 ft. by 2 ft. spacing is too wide. This experiment shows that 3 ft. by 1 ft. spacing is too wide. The spacing 1 ft. by 1 ft. though not significantly better than 2 ft. by 1 ft. in the lined plots, would appear to be the best spacing for spreading groundnuts. Line sowing has shown no definite advantage over broadcasting, and ridging has had no effect on yield.

SWEET POTATOES.

Five separate acres were planted with different varieties of sweet potatoes for observation with regard to yield. The crop was planted in May and June and remained in the ground until the dry weather, being dug up in January. Yields were very good. In order to determine the cost of cutting and drying for storage the bulk of the crop was sliced and dried, the ratio of fresh potatoes to the dry material being determined.

TABLE XVIII.

YIELDS FROM ONE ACRE OF SWEET POTATOES IN LBS.

Variety.					Weight Fresh.		Percentage Dried.
Ayogogo	...	...	...	...	11,176	...	34
Chantikomatek	...	...	...	...	21,360	...	21
Ojone	...	...	...	...	27,360	...	26
Oyane	...	...	...	...	13,081	...	29
Wakala	...	...	...	...	13,149	...	25
AVERAGE YIELD PER ACRE	...	...	...	...	17,205 lbs.	...	26
					7 tons 14 cwt.		1 ton 19 cwt.

On another plot a collection of all the sweet potatoes met with by the Agricultural Officer when on safari has been planted for observation.

CASSAVA.

In view of the importance of cassava as a famine reserve it was decided to undertake more work with this crop. As a preliminary to possible further experiments a collection of Lango varieties was made. Also the common variety *Bitamisi* is being planted in strips, month by month, from October last in order that the relative yields throughout the year may be indicated.

GRASSES.

A collection of grasses was made with a view to finding which of them is most suitable for use in pasture making. Some were collected locally and some were grown from seed supplied by the Botanist. The following grasses have useful qualities:—

Setaria spaceolata var. "Achanaya."

Panicum maximum.

Cynodon dactylon.

Another grass worthy of further trial was *Setaria spaceolata* var. "Alele." An *Indigophora*, other species of perennial grasses, and some annuals were also tried.

Costings.—A record of the man-days employed on cotton, spreading groundnuts, and sweet potatoes was kept. Owing to the failure of the sim-sim and the destruction of the grain crops and kapenda no other figures can be given.

TABLE XIX.

SUMMARY OF COSTS OF PRODUCTION IN MAN-DAYS PER ACRE.—NGETTA, 1931.

	Cotton.		Spreading Groundnuts.		Sweet Potatoes.	
Ploughing	...	5	...	1	...	—
Harrowing	...	2	...	3	...	—
Making mounds	...	—	...	—	...	38
Planting	...	8	...	11	...	5
Re-sowing	...	1	...	—	...	—
Singling	...	2	...	—	...	—
First weeding	...	5	...	7	...	4
Second and third weeding	...	7	...	5	...	—
Harvesting	...	12	...	118	...	229
Uprooting	...	1	...	—	...	—
TOTAL MAN-DAYS	...	43	...	145	...	276
YIELD PER ACRE	...	194 lbs.	...	926 lbs. (unshelled)	...	21,269 lbs.

The above yields are abnormally low for cotton and high for sweet potatoes. In the latter the high cost of harvesting is due to slicing and drying a heavy crop of potatoes, a much larger crop than would be required for food by a Lango family.

Wanyange Lukiko Farm.—This is a new farm opened this year with a grant from the Busoga Native Administration. The site chosen was very densely forested, which cost as much as Shs. 133 per acre to clear. About 13 acres have been cleared and are now ready for cultivation. There is also an area of five acres of partially cleared land which was planted with oil palm. These latter have suffered from the attentions of monkeys but the remainder are doing quite well. The 13 acres were sown with sann hemp preliminary to cultivation in 1932 when a programme of experimental work suitable to Busoga will be arranged.

Kamuge Lukiko Farm.—This farm of six acres is divided into two parts, one providing three one-acre plots which are cropped on the Eastern Province rotation, and the other three plots used for experimental work including a cotton variety trial. The spring maize crop was destroyed by locusts but late maize produced 1,106 lbs. per acre, which, though not a high yield is probably about the average for maize planted at this time. *Dolichos lablab* and *Crotalaria alata* were used as cover crops. A new area was cleared for work with cassava, the two varieties *Bitamisi* and *Kachachali* being planted in strips at monthly intervals.

Bubulu Lukiko Plantation.—An acre of *Arabica* coffee is maintained on this farm of six acres. The remaining land is divided up so as to provide three plots worked on the standard rotation and three plots which test a modification of it. The latter variation has the grain crop at the end of the year, changing places with sim-sim which in this case is grown in the spring before cotton. Small observation plots of green manures were put down. Of *Canavalia ensiformis*, *Mucuna pruriens*, *Crotalaria alata*, *C. incana*, *C. intermedia*, *indigofera anil*, the best cover crop, remaining down for five months, was *Mucuna pruriens* (*Stizolobium*). *Crotalaria incana* was outstanding for its rapid growth and quick maturity. As a cover crop for coffee *C. alata* was promising as it grew well here and at Bugusege.

SECTION 3.

DISTRICT EXPERIMENTAL WORK.

The management of the many experimental plots situated outside the experiment stations was a matter of some difficulty owing to the fact that Agricultural Officers were engaged in anti-locust campaigns. On many of the plots the crops were destroyed by locusts and where they were re-sown yielded badly owing to being planted late.

ROTATION PLOTS.

These plots are situated at county headquarters in Lango, at five centres in Teso and at Kamuge and Bubulu. The rotation is also under observation at Ngetta and in the rotation experiment at Serere.

The rotation, as originally suggested, includes economic crops to be grown in the late rains. In many areas this is not customary and it was necessary to determine whether it was possible to obtain good crops of groundnuts, sim-sim, and cereals when planted in the latter part of the year.

At two centres in Teso "sowing-date strips" have been planted since 1929. These consists of 1/20-acre single plots which have been sown at fortnightly intervals from March 14th to May 14th and from July 14th until September 14th with groundnuts, sim-sim, and bulo. In order to get an answer to the same question groundnuts and sim-sim were sown in September, 1931, in the quarter-acre comparison plots which are scattered all over the Eastern Province.

The sowing date strips in Teso have shown, over a period of three years, that no yield can be expected from the three crops if they are planted after August 14th. The $\frac{1}{20}$ -acre plots were unprofitable, very small harvests being obtained in all districts showing that September is too late, with the possible exception of Busoga district. In Busoga the $\frac{1}{20}$ -acres yielded less than half the weight of groundnuts and sim-sim that could be expected from spring crops.

Further investigations into rotations are being made on Instructors' Rotation Shambas, where the Instructor in return for the loan of a plough, is expected to furnish accounts of his profits from economic crops and to supply figures showing the food consumption of his family. The economic crops are grown in the rotation suggested by the Department. Supplementary food crops will be grown in a separate rotation to be devised according to the experience gained. Three such rotation farms have been started in Lango. Two more are to be opened in Teso during the coming year, and useful results are expected as soon as the hoped for passing of the locust menace enables the people to return to their normal diet.

COTTON EXPERIMENTS.

Variety Trials.—The Cotton Botanist's variety trials which were conducted at three centres in Lango, four in Teso, and one each in Bugwere and Busoga are reported on by him.

$\frac{1}{20}$ -acre Comparison Plots.—The number of these pairs of trial plots was increased to fifty, evenly spaced all over the cotton growing areas of the Eastern Province. The variety S.G. 29 was tested against N. 17. The yield records and samples of cotton were sent to the Cotton Botanist.

Cotton Spacing Trials.—Two spacing trials were done in Busoga to test 4 ft. by $1\frac{1}{2}$ ft. against 3 ft. by 1 ft. spacing in that district. At Vukula the experiment was planted in June. At Kitaunjwa August planting was adopted. The lay-out was the same at both places, being repetitions of the two treatments in random pairs. The size of the plots was 24 ft. by 39 ft. at picking time after outside rows and outside plants had been cut down.

Results.—

VUKULA. MEAN YIELDS OF COTTON.				
Spacing 4 ft. by $1\frac{1}{2}$ ft.	...	...	...	8.43 lbs.
„ 3 ft. by 1 ft.	...	...	...	8.53 lbs.
KITAUNJWA. MEAN YIELDS OF COTTON.				
Spacing 4 ft. by $1\frac{1}{2}$ ft.	...	...	...	11.3 lbs.
„ 3 ft. by 1 ft.	...	...	...	12.1 lbs.

These results are in agreement with those obtained from experiments in other districts in showing that there is little difference to be expected from close spacing when cotton is planted early but the advantage is with 3 ft. by 1 ft. spacing with later cotton. The difference between the yields of the Kitaunjwa trial is, however, not big enough for statistical significance.

Kapenda Breakpan Experiment.—In view of the special soil conditions of Usuku an experiment was put down to test the effect of growing kapenda (*Cajanus*) before cotton. It is possible that the deep roots of the kapenda may penetrate the sub-soil, which tends to form a pan, and thus open it for the benefit of the succeeding cotton crop. Five pairs of plots were sown as random pairs. One of each pair carries a crop of kapenda, and the other, being the control, had a crop of cowpea, so that it should not be at a disadvantage with regard to fertility. All the plots will be planted with cotton next May after the kapenda has been uprooted.

Ridge Cultivation.—Another experiment which may prove to be of value in connection with agriculture in Usuku was commenced. It consists of ridge cultivation, on ridges two-and-a-half feet high. An ordinary rotation will be grown on these ridges for a number of years, when they will be split so that the soil is thrown back and a new surface is exposed. The experiment is arranged in pairs of plots ridged and flat. Unfortunately it was begun too late for a good cotton crop to be obtained but it was noticeable that the roots of cotton on the ridges were four times longer than those of the cotton in the flat plots. The roots of the former would have gone deeper but for the fact that they bent at right angles at the same level as the "flat" plants—on reaching the pan.

GROUNDNUT EXPERIMENTS.

An experiment was laid down at Katakwe and repeated at Toroma with the following objects.

To compare spreading groundnuts when sown:—

In lines	} at 2 ft. by 1 ft. spacing.
Broadcast	
Ridged	
In lines at $1\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft. spacing.	

To compare bunch groundnuts:—

Broadcast	} at 1 ft. by 1 ft. spacing
In lines	

and to compare the yields of the two types.

There were five randomised blocks of plots 12 ft. by 135 ft. making thirty plots at each centre.

Results.—No results were obtained from this experiment owing to heavy infestation of rosette disease, and the destruction of the bunch groundnuts by locusts.

A number of single plant selections were made, in these plots, of plants which had no sign of rosette disease and the seed from them will be planted for observation and further selection next year.

SECTION 4.

BUGUSEGE COFFEE PLANTATION.

This plantation, which is supervised by the Agricultural Officer for Bugishu district, is devoted entirely to experimental work with *Arabica* coffee, with a view to the conclusions drawn from the experiments being used as a basis for advice to the native coffee growers in the district.

PLANTATION PRUNING EXPERIMENT.

* *Object.*—To compare the yields of coffee pruned on the single stem, multiple stem and Agobiada systems.

Lay-out.—With five repetitions the three treatments are planted in plots containing seven rows of coffee planted at 8 ft. by 8 ft. spacing. All plots are mulched with banana fibre. The experiment was planted in 1927 and the first crop was taken in the 1929–1930 season. It should be noted that three extra blocks were planted a few months after the first five and these could not be used in the calculation of the results from the first pick. Results are now taken from all eight blocks.

Results.—

TABLE XX.

MEAN YIELDS OF CHERRY IN LBS.							
	Agobiada.		Multiple Stem.		Single Stem.		Mean of 5 plots.
1929	.. 87.0	...	79.6	...	123.3	...	
1930-31	... 606.8	...	427.6	...	347.3	...	91 39 33 31
1931-32	... 445.6	...	102.9	...	86.1	...	39 33 8 33
1929-1932	... 1064.7	...	583.0	...	548.2	...	33 33 33 33

In the 1931–32 crop the experiment satisfies the Z test when $P = .01$. Differences of 98 are significant so that Agobiada is significantly better than multiple and single stem, with no difference between the last two.

In the total crop from 1929–1932 the experiment also satisfies the Z test when $P = .01$. Differences of 236.8 are significant so that Agobiada is significantly better than the other two, between which the difference in yield is not significant.

Discussion.—Comparing these results with those of the first crop it will be seen that the single-stem plots at first yielded more than the other two, but that the position was reversed in the following year when Agobiada took the lead. The relative positions shown by the 1930-31 results have been maintained and in the total the order is still Agobiada, multiple stem, and single stem, with a large balance in favour of the Agobiada system.

The single stem trees suffered from die-back after their first crop. They are again promising to bear a heavy crop which may result in more die-back. The Agobiada plots will also yield well in the coming year. These trees have so far shown no sign of exhaustion through overbearing, and it appears probable that the superiority of this treatment will not be lessened by the yields from the single-stem plots. The multiple-stem trees have suffered little from die-back. They bear steadily but show no signs of competing for first place with Agobiada.

COFFEE MANURING EXPERIMENT.

Object.—To compare the yield from coffee manured in different ways, covered, or clean weeded. The treatments are given below:—

- A. Clean weeded.
- B. Green manure—two covers a year.
- C. Banana leaf mulch.
- D. Ordinary weed cover.
- E. Leguminous cover crop—October to March—and clean weeded for the rest of the year.

Lay-out.—This experiment was planted in 1928 as a Latin square. The plots contain five rows of trees at 8 ft. by 8 ft. spacing. The trees are pruned on the single stem system but are now allowed unlimited terminal growth.

Results.—Two crops have been taken from this experiment.

TABLE XXI.

MEAN YIELDS OF FIVE PLOTS IN LBS. OF CHERRY.

	1930-31.	1931-32.	Total.
A. Clean weeded	... 189.9	... 407.8	... 597.2 (1)
B. Green manure (2)	... 183.6	... 315.0	... 498.7 (4)
C. Banana leaf mulch	... 168.1	... 390.0	... 558.3 (3)
D. Ordinary weed cover	... 205.0	... 255.4	... 460.5 (5)
E. Leguminous cover crop October—March	... 191.6	... 405.0	... 596.6 (2)

In the mean yields of the combined crops the experiment satisfies the Z test when $P = .05$. Differences of 77.1 are significant and,

Treatments A, C and E are significantly better than D.

Treatments A and E are significantly better than B.

The 1930 yields were not significant. The 1931-32 yields by themselves gave significant differences in support of those mentioned above with the addition of treatment B to those which are better than D, and treatment C to those which are better than B.

Discussion.—In general, the order of yields is in favour of the treatments where the ground is bare for the whole or part of the year. Of the covered plots there is an indication of banana leaf mulch being the best. Ordinary weed cover which appeared to be doing best of all in the first crop is now worse than all the others.

As this is only the second crop from the experiment it is too early yet to draw conclusions.

NEW EXPERIMENTS.

The following experiments have not yet borne a crop:—

Pruning Experiment.—This is designed to test a simple form of multiple stem pruning which may be suitable for natives to use, against single stem pruning and natural growth. This experiment was planted in 1930.

Manuring Experiment.—This is a duplication of the manuring experiment described above with the addition of two treatments: (f) mulching with banana stems, (g) growing *Leucana glauca* between the rows and periodically cutting it down. The trees, in this experiment, which were planted in 1931 will be pruned on the modified multiple stem system.

Shade Experiment and Spacing Experiment.—It was not found possible to plant these experiments during 1931, but the land had been cleared and holes had been dug at the end of the year so that the trees could be put in at the break of the rains.

COFFEE PESTS AND DISEASES.

Stephanoderes hampei, the coffee berry borer, was present to a large extent at Bugusege during 1931, being especially noticeable towards the end of the crop, when it did considerable damage. *Ceratites*, a fruit fly, was common in the mucilaginous coat inside the cherry, *Antestia* was present on the plantation but did little damage. *Hemilea vastatrix* and *Cercospora* were to be found but were not harmful.

COVER CROPS.

Mucuna pruriens (Stizolobium), *Crotalaria alata*, *C. intermedia*, *C. anagyroides*, *Indigofera anil* and *Centrosema tomentosa* were tried at Bugusege.

As a cover crop giving bulk and quick growth without excessive woodiness *Mucuna pruriens* was the best. *Centrosema* grew slowly but eventually gave a close ground cover. Of the *Crotalarias*, *C. incana* gave an excellent cover, seeded well and would make a good cover crop for coffee if kept cut close to the ground.

Fermentation experiments with coffee showed that the time required for fermentation varied somewhat on different days. The optimum time appears to be 21 to 22 hours when begun in the afternoon.

SUMMARY.

1. Cotton spacing experiments were conducted at Serere, Ngetta, and at two centres in Busoga. 3 ft. by 1 ft. spacing gave higher yields than 4 ft. by 1½ ft. in all the experiments. The Ngetta trial in which spacing was combined with sowing date showed that early planting gives a higher yield than late planting. At Serere planting nine seeds per hole gave the best stand but the difference was not great enough to affect the yield as compared with plots planted with three, six, and twelve seeds per hole. See Sections 1 (A), 2 and 3.

2. Ratooning of cotton was found to be undesirable. An experiment carried out at Serere is described in Section 1 (A).

3. Experiments to test ridge cultivation of cotton on large ridges which can be used for a rotation of crops have been laid down at two centres in Usuku. See Section 3.

4. Yields of cotton on the Seed Farm were below the average. See Section 1 (B).

5. Yield figures of fifty pairs of ¼-acre comparison plots were handed over to the Cotton Botanist. See Section 3.

6. Groundnut cultural trials were carried out at Serere, Ngetta, and in Usuku. These are described in Sections 1, 2 and 3. 1 ft. by 1 ft. spacing was found to be better than wider spacings for bunch groundnuts. No advantage was gained by sowing in lines, or on ridges, over the ordinary method of broadcasting. 1 ft. by 1 ft. was found to be better than wider spacings, at Ngetta, for the spreading groundnut.

7. Bunch groundnuts yielded considerably better than the spreading type at Serere. *See* Section 1.

8. Rosette disease was found to be more prevalent in the widely spaced plots of the groundnut experiments.

9. Cost accounting of groundnut cultivation by different methods done at Serere showed that native methods of groundnut growing were not more expensive than when line sowing and ploughing out at harvest are adopted. This experiment is described in Section 1 (B).

10. Experiments on the sowing date and seed rate for sim-sim are described in Sections 1 (A) and 2.

11. The rotation experiment at Serere and outside experiments on rotations are described in Sections 1 (A) and 3.

12. An account of the Agricultural Chemist's Erosion Experiment will be found in Section 1 (B).

13. Sann hemp retting trials conducted at Serere from plots sown at varying seed rates are described in Section 1 (B).

14. A seed rate trial with mtama (Sorghum) showed that 16 lbs. per acre was the best. *See* Section 1 (A).

15. Work with oil palm, Shea nuts, green manures and other crops grown on the Seed Farm is described in Section 1 (B).

16. Work with sweet potatoes with costings, and also costings of other crops done at Ngetta are given in Section 2.

17. Section 4 is devoted to the coffee experiments at Bugusege plantation.

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Senior Agricultural Officer.

ANNUAL REPORT, BUKALASA EXPERIMENTAL STATION, 1931—1932.

METEOROLOGICAL.

The work carried out on the plantation may be divided into three main divisions:—Cotton Selection, Agricultural Education and General Experimental work. Detailed accounts of the first two sections will be found in the reports of the Cotton Botanist and the Superintendent of Agricultural Education. This report deals only with general experimental work.

52.53 inches of rain were registered during the year April, 1931, to March, 1932, the average for the preceding ten years being 52.44 inches.

During the first rains weather conditions were ideal for the growth of food crops and excellent stands were obtained, especially in the maize experiments. Unfortunately swarms of locusts made their appearance during the middle of May, and on the evening of the 23rd May a large swarm settled on the plantation and destroyed all the grain experiments, while damage was also done to the banana, plantain and groundnut experiments.

Sim-sim generally suffered from attacks of leaf spot, *Cercospora sesami*.

The second rains while favourable for the early stages of growth in cotton were too prolonged and the spread of Angular Leaf Spot and, to a less extent, of Blackarm was thereby encouraged. Lygus were very numerous and did considerable damage to young plants. Bud and boll shedding became very high while the cotton developed into tall straggling trees with very little sound foliage.

A dry period at the end of the year hastened ripening but continued dry weather early in 1932 resulted in a certain amount of immature lint.

GENERAL.

New land has been opened up for spacing and cover crop experiments with robusta coffee, and for cotton breeding plots and variety trials.

COTTON.

Sowing Date and Spacing Experiment.—The object of this experiment and the results of the previous two years were given in the 1930 report.

Lay-out.—A 10 by 10 Latin square, each plot measuring 1/43-acre. Two spacings, 3 ft. by 1 ft. and 4 ft. by 2 ft. in the following sowing dates: mid June, end of June, mid July, end of July, mid August.

TABLE I

		Mid June.		End June.		Mid July.		End July.		Mid August.		Means.	S. E.
		3×1	4×2	3×1	4×2	3×1	4×2	3×1	4×2	3×1	4×2		
Total lbs.	...	34.6	40.5	36.2	37.1	21.0	24.4	13.0	11.6	6.1	4.7	22.92	± 2.128
Means	...	3.46	4.05	3.62	3.71	2.10	2.44	1.30	1.16	0.61	0.47	2.292	± 0.2128
Lbs. per acre	...	148.78	174.15	155.66	159.53	90.3	104.92	55.9	49.88	26.23	20.21	98.56	...
Percentages	...	151	176.8	158	162	91.8	106.4	56.6	50.6	26.5	20.5	100	± 9.31

These results are significant according to Fisher's Z test:—

In the Spacings:—4 ft. by 2 ft. mid June is significant over all other treatments. There is no significant difference between spacings in the other sowing dates.

In the Sowing Dates:—Mid June and end of June are significant over the later sowing dates. Mid July over end of July and mid August, and end of July over mid August.

Conclusions.—The above results indicate that, for the area which Bukalasa represents, June sown cotton gives a larger yield than cotton planted in July and August. This is borne out by the previous two years' experiments when the same result was obtained.

The only significance in the spacings is in the first sowing when the wider spacing was the more successful. This result is contrary to previous years' results when closer spacings have given better yields at all sowing dates. It is probable that the wet season accounts for this change as most of the early sown cotton became very woody, and this excessive vegetative growth was more harmful in the closer spacing, the plants in these plots becoming a tangled mass.

Subsoiling Experiment.—The object of this experiment was detailed in the report for 1930—31.

Lay-out.—Twelve 1/6-acre strips in A B B A A B B . . . A pattern. Six of these strips subsoiled to a depth of 15 inches and the whole ploughed and planted with cotton at a spacing of 3 ft. by 2 ft. on the 15th June. The season was very wet, and the plants went badly to wood. Angular Leaf Spot was prevalent in July followed by Blackarm, but the attack of the latter was not severe. Lygus did considerable damage in September.

Results.—

		Control.		Subsoiled		Means.	S.E.	
Totals (6 plots) lbs.	...	148	...	143	...	145.3	...	±5.079
Means	...	24.7	...	23.9	...	24.3	...	±0.847
Lbs. per acre	...	148.0	...	143.0	...	145.5	...	—
Percentages	...	101.7	...	98.3	...	100.0	...	±3.48

According to Fisher's table Z these results are not significant.

Conclusions and Comparisons.—The growing season was very wet and the cotton went to wood and it would seem that under these conditions the beneficial effects of deep rooting are not so marked. In the previous year—a comparatively dry season—the yields from the subsoil plots were significantly greater than those from the controls, and the mean yield from the experiment was much higher, being 423 lbs. per acre compared with 145 lbs. obtained in 1931.

Interplanting and Mulching Experiment.—The object of the interplanting experiment was outlined in the 1930 report. In 1931 it was decided to include, in this experiment, mulching with elephant grass, as the second mulching experiment described below only covers late sown cotton.

Lay-out.—Five random blocks of the following six treatments:—

- (1) interplanting with groundnuts at the time of germination of cotton;
- (2) interplanting with beans at the same time;
- (3) interplanting with groundnuts one month after germination;
- (4) interplanting with beans one month after germination;
- (5) mulching with elephant grass to a depth of six inches as soon as the cotton was singled.
- (6) control.

Each plot measured 48 ft. by 36 ft. The cotton was planted on the 24th June at a spacing of 4 ft. by 2 ft. and, in the first four treatments, single rows of beans or groundnuts were planted between the cotton. Germination of the cotton took place on the 3rd July and the plants were singled on the 24th July. In the mulched plots flowering commenced earlier and the flowering peak was two weeks earlier than in any of the other treatments. Flowering counts were taken on two consecutive days each week and the means are shown in Fig. I.

Results.—

	Mulched.	Early Groundnuts.	Early Beans.	Late Groundnuts.	Late Beans.	Control.	Means.	S.E.
Total (5 plots) lbs.	... 73.6 ...	... 45.6 ...	... 41.7 ...	... 45.4 ...	... 48.9 ...	... 42.8 ...	... 49.7 ...	±4.6
Means	... 14.7 ...	... 9.1 ...	... 8.3 ...	... 9.1 ...	... 9.8 ...	... 8.6 ...	... 9.94 ...	±0.92
Lbs. per acre	... 862.5 ...	... 227.5 ...	... 207.5 ...	... 227.5 ...	... 245.0 ...	... 215.0 ...	... 247.5 ...	—
Percentages	... 148.0 ...	... 91.5 ...	... 83.5 ...	... 91.5 ...	... 98.7 ...	... 86.6 ...	... 100 ...	±9.26

YIELDS OF INTERPLANTED CROPS.

	Early Groundnuts.	Early Beans.	Late Groundnuts.	Late Beans.
Total (5 plots) lbs.	... 29 ...	... 49 ...	... 8.69 ...	... 26.5 ...
Means	... 4 ...	... 9.8 ...	... 1.74 ...	... 5.3 ...
Lbs. per acre	... 100 ...	... 245 ...	... 43.5 ...	... 132.5 ...

With regard to the cotton yields, according to Fisher's Z test the mulched cotton gave a significantly greater yield than any of the other treatments, between which there is no significant difference.

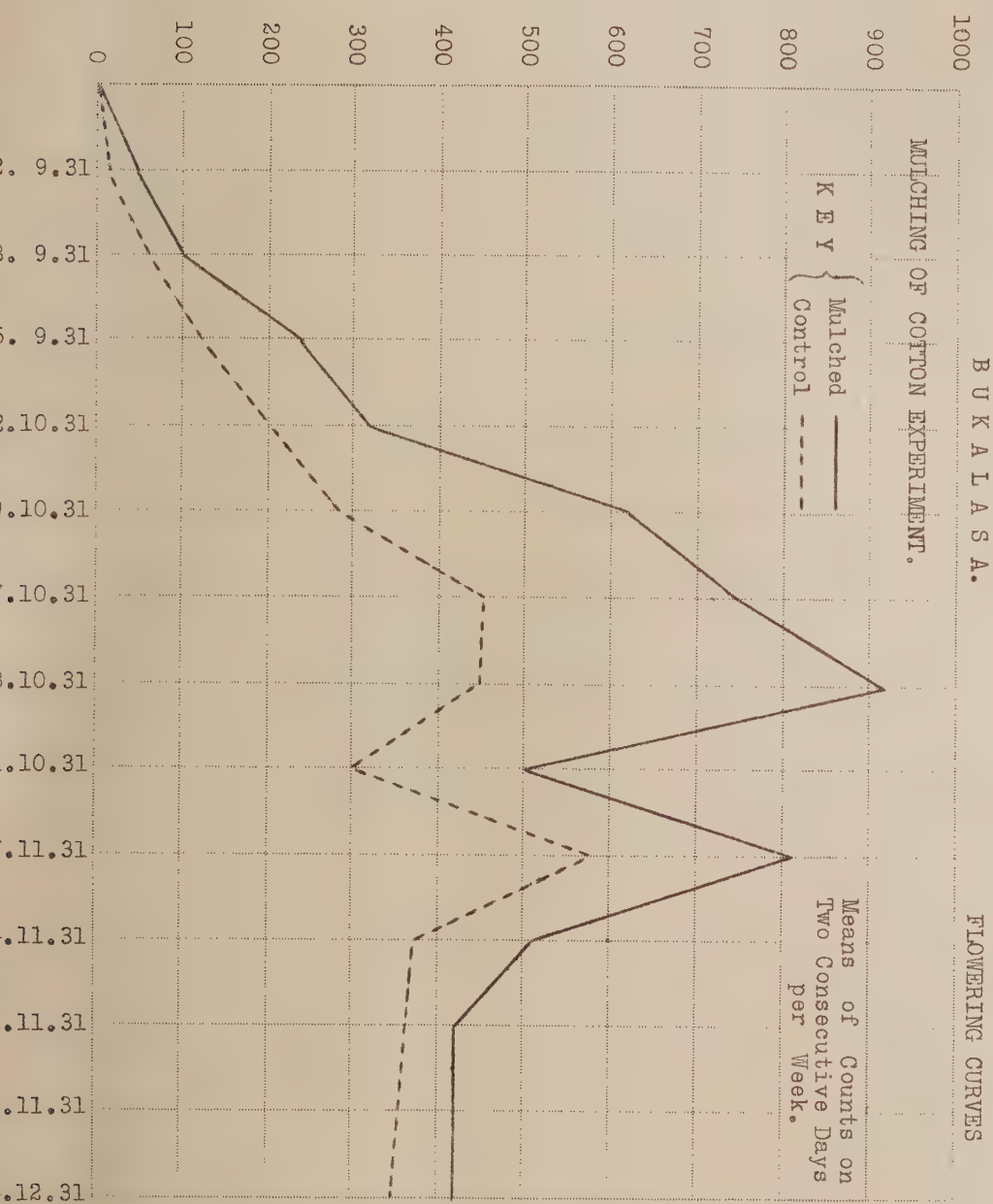
Conclusions.—These results bear out the indications obtained in the mulching experiment of 1930, namely, that mulching gives an increase in the yield of cotton. The 1930 season, however, was dry, and the mulch may then have had a beneficial effect in conserving the water supply. In 1931 there was a rainfall above normal during the first three months of the plants' growth.

The results obtained from interplanting when compared with those of the previous season indicate that water is to a great extent the limiting factor. In the 1930—31 season when the growth of the beans and groundnuts coincided with a dry period the control plots gave a significantly greater yield than the interplanted, while during the 1931—32 season, when the growth of these crops coincided with a wet period, there was no significant difference.

MULCHING OF LATE SOWN COTTON.

Object.—The native cultivator is often unable to plant all his cotton during the optimum planting period of June and July and it is usual for cotton sown later than this period to give a very poor yield. In order to find out whether it would be possible to make this late sown crop an economic proposition an experiment was laid down with cotton planted during the first week of August and during the first week of September and mulched with elephant grass to a depth of six inches.

FLOWERS PER TREATMENT.



Lay-out.—Eight random blocks of the four treatments: August sown control, August sown mulch, September sown control and September sown mulch. The mulching was done five weeks after planting, each subplot measuring 36 ft. by 28 ft., and containing 126 plants at a spacing of 4 ft. by 2 ft.

Results.—Flowering counts were taken on two consecutive days each week and in both cases the mulched plots produced more than double the number of flowers than their respective controls. The flowering peaks were also a week earlier than those of the controls. Lygus attacks on the young plants were severe but the percentage boll shedding appeared to be less in the mulched plots.

	<i>August Control.</i>	<i>August Mulch.</i>	<i>Sept. Control.</i>	<i>Sept. Mulch.</i>	<i>Means.</i>	<i>S.E.</i>
Totals (8 plots) lbs.	19.1	52.5	5.8	16.2	23.4	± 2.657
Means	2.39	6.56	0.73	2.02	2.92	± 0.332
Yield per acre, lbs.	102.77	282.08	31.39	86.86	125.77	
Percentages	81.8	224.7	25.0	69.2	100.00	± 11.4

The result is significant according to Fisher's table Z and shows that mulching of August sown cotton increases the yield by 180 lbs. per acre, that the earlier sowing date gave a significantly higher yield than the later in the controls, and that mulching of the September sown cotton gave an increase in yield of 55 lbs. per acre, there being no significant difference between the August control plots and the September mulched plots.

Conclusions.—These results bear out the indication obtained in the previous year's mulching experiment where mulching gave an increase yield in cotton, but which result was not significant owing to insufficient repetitions.

RIDGING EXPERIMENT.

Object.—To determine whether any increase in yield is obtained by planting cotton on ridges. It is thought that root development might be encouraged, and in addition land ridged across the slope helps to prevent soil erosion.

Lay-out.—Eight random blocks of two plots each, each plot 1/18-acre. Ridges 4 ft. apart. Cotton was planted on the 29th June at a spacing of 4 ft by 2 ft. The ridged cotton became badly laid by the heavy rains.

Results.—

	<i>Control.</i>	<i>Ridged.</i>	<i>Mean.</i>	<i>S.E.</i>
Totals (8 plots) lbs.	55.9	55.6	55.75	± 2.236
Means	6.99	6.95	6.97	± 0.28
Lbs. per acre	125.8	125.1	125.45	
Percentages	100.28	99.72	100.00	

There is no significant difference between the two treatments.

Conclusions.—It would seem that under Bukalasa climatic and soil conditions, no advantage is to be gained from planting cotton on ridges, as the results for the past two years show no significant difference.

LIME AND GREEN MANURE EXPERIMENT.

The results of this experiment will be found in the report of the Agricultural Chemist.

FOOD CROPS.

GROUNDNUTS.

SPACING TRIAL.—

Object.—To ascertain the optimum spacing for bunch type groundnuts.

Lay-out.—A 4 by 4 Latin square with plots of 900 square yards each. Planted with the Bukalasa bunch variety of groundnuts on the 27th February at the following spacing:—1 ft. by 1 ft., 1½ ft. by 1 ft., 2 ft. by 1 ft., 2 ft. by 2 ft. Some damage was done to the foliage by locusts.

Results.—

	<i>1 ft. by 1 ft.</i>	<i>1½ ft. by 1 ft.</i>	<i>2 ft. by 1 ft.</i>	<i>2 ft. by 2 ft.</i>	<i>Means.</i>	<i>S.E.</i>
Totals, lbs.	1,176	1,094	967	467	926	± 119.6
Means	294	273.5	242	117	231.5	± 29.9
Lbs. per acre	1,578	1,477	1,307	631	1,251	
Percentages	127	118	105	51	100	± 13

The 1 ft. by 1 ft. spacing gave a significantly greater yield than the 2 ft. by 1 ft. and 2 ft. by 2 ft., while the 1½ ft. by 1 ft. spacing gave a significantly greater yield than the 2 ft. by 2 ft. spacing.

Ridging Experiment.—An experiment designed to find out whether groundnuts grown on ridges produce a larger crop than those grown on the flat.

No significant differences in yield have been obtained during the past two years.

MAIZE.

In the spring rains all maize experiments were completely destroyed by locusts.

SPACING TRIAL.—

Lay-out.—Eight random blocks of two plots of two spacings:—3 ft. by 1 ft. and 4 ft. by 1 ft., subplots measuring 1/30-acre. The maize was planted in August and suffered slightly from attacks of locusts.

Results.—

		3 ft. by 1 ft.		4 ft. by 1 ft.		Means.
Totals, lbs.	...	1,242	...	1,241	...	1,241.5
Means	...	155.25	...	155.125	...	155.2
Lbs. per acres	...	4,657	...	4,654	...	4,656
Percentages	...	100.02	...	99.98	...	100.00

There is no significant difference between the results.

SWEET POTATOES.

Variety trial.—An experiment designed to test the yielding capacities of the six commonest varieties of sweet potatoes grown in Bulemezi county.

Lay-out.—Six random blocks of the following varieties:—Kawa, Kifefe, Buwala, Kiwoko, Nakamogoli and Magabali, planted on 21st February in 1/48-acre plots and harvested in August.

Results.—

	Magabali.	Kifefe.	Kawa.	Nakamogoli.	Buwala.	Kiwoko.	Means.	S.E.
Totals, lbs.	823	430	407	304	244	129	389.5	± 65.09
Means	137	72	68	51	41	21	65	± 10.85
Lbs. per acre	6,576	3,456	3,264	2,448	1,968	1,008	3,120	
Percentages	215	110.8	104.6	78.5	63.1	32.3	100.00	± 16.7

Magabali gave a significantly greater yield than any of the other varieties, Kifefe and Kawa significantly greater than Buwala and Kiwoko, and Nakamogoli significantly greater than Kiwoko. In previous years there have been no significant differences, but only indications that Nakamogoli was the best cropper.

SIM-SIM SPACING TRIAL.

Lay-out.—A 4 by 4 Latin square of 1/24-acre plots with sim-sim planted at the following spacings:—2 ft. by 1 ft., 2 ft. by 6 ins., 1 ft. by 1 ft., and 1 ft. by 6 ins., on 28th March. Germination was poor and the crop was badly attacked by *Cercospora sesami*.

Yields.—

		1 ft. by 6 ins.	1 ft. by 1 ft.	2 ft. by 6 ins.	2 ft. by 1 ft.	Means.	S.E.
Totals, lbs.	...	32	30	27	17	26.5	± 3.742
Means	...	8	7.5	6.75	4.25	6.625	± 0.935
Lbs. per acre	...	192	180	162	102	159	
Percentages	...	120.5	113	102	64.5	100.00	± 14

The three close spacings gave significantly greater yields than the 2 ft. by 1 ft. spacing.

BEANS VARIETY TRIAL.

Lay-out.—A 4 by 4 Latin square with plots 1/36-acre, planted with the following varieties: Mutike, Navy, Wagtail, and Serere beans on the 8th May at a spacing of 2 ft. by 1 ft.

Results.—

	Mutike.	Navy.	Wagtail.	Serere.	Means.	S.E.
Total yield, lbs.	54	49	17.5	16	34.1	± 4.44
Mean yield	13.5	12.25	4.37	4.0	8.5	± 1.11
Lbs. per acre	486	441	157.5	144	306.9	
Percentages	159	144	51.4	47	100.00	± 13.1

Mutike and Navy gave significantly greater yields than Wagtail and Serere beans. These results indicate that Mutike is the best yielder and this is borne out by the previous years' results when Mutike gave significantly greater yields than the remainder.

PLANTAINS.

Method of Cultivation Experiment.—The objects of this experiment and methods of treatment were detailed in the report for 1930.

Lay-out.—Five random blocks of 2 plots, each plot measuring 672 square yards.

Results.—

	Jamaica method.	Buganda method.	Means.	S.E.
Totals (8 plots) lbs.	7,074	8,595	7,834.5	± 871.2
Means	1,414.8	1,719	1,566.9	± 174.24
Lbs. per acre	10,189.9	12,402.5	11,296.2	
Percentages of means	90.5	109.5	100.00	± 11.1

There is no significant difference between yields of two methods.

Weight per bunch.—

	Jamaica method.	Buganda method.	Means.	S.E.
Mean weight per bunch, lbs.	27.4	14.2	20.8	± 1.6
Percentages	131.8	68.2	100.00	± 7.69

The Jamaica method gives a significantly larger bunch than the Buganda method.

Conclusions.—There is a big variation in the yields of the subplots due to five of them, three of which are Jamaica method of planting, being alongside a row of *Cedrella toona* trees. Thus no significant difference has been obtained in the yields, but these results, as well as those obtained in 1930, show that a definitely bigger bunch can be obtained from the Jamaica

method. It is also noticeable that the decrease in size of bunch as the plantains get older is not so marked in the Jamaica method, the mean weight per bunch decreasing from 29.7 lbs. in 1930 to 27.4 lbs. in 1931, while in the Buganda method it decreased from 22.8 lbs. in 1930 to 14.2 lbs. in 1931.

DEMONSTRATION SMALL HOLDING.

Details of this holding were given in the 1929 and 1930 reports. The past year has been unfortunate for the tenant inasmuch as his spring crop of maize was destroyed by locusts and his autumn crop damaged by these pests. Owing to attacks of leaf spot his simsim gave but a poor yield.

No extra help was required, as the work was well within the tenant's capacity. During the coming year the holding is to be enlarged to four acres as it has now been proved that, with the present rotation, one man and his family should be able to farm this area.

Returns for the past year are as under:—

									Shs. cts.
Simsim	...	...	45 lbs.	@	cts. 10	per lb.	=		4 50
Groundnuts	...	...	126 "	"	"	10 "	"	=	12 60
Beans	...	...	27 "	"	"	10 "	"	=	2 70
Cowpeas	...	...	53 "	"	"	20 "	"	=	10 60
Sweet potatoes	...	...	1,057 "	"	"	02 "	"	=	21 14
Cassava	...	...	1,144 "	"	"	01 "	"	=	11 44
Maize	...	...	1,631 cobs	"	"	03 "	cob	=	48 93
Cotton:—									
A quality	...	...	178 lbs.	@	12 cts.	per lb.	}	=	22 24
B " "	...	...	22 "	@	4 "	"			
TOTAL NET PROFIT									134 15

The net profit in the four preceding years is as under:—

1927-28: Shs. 108/16; 1928-29: Shs. 149/20; 1929-30: Shs. 162/26; 1930-31: Shs. 163/77.

ROBUSTA COFFEE.

Shade and Cover Crop Experiment.—The objects and lay-out of this experiment were detailed in the 1930 report. The first small crop was picked in July and the first main crop in November—December.

TABLE II.

	No shade.			Banana shade.			Gliricidia shade.				
	Weeded.	Cover Crop.		Weeded.	Cover crop.		Weeded.	Cover crop.		Means.	S.E.
Total 6 plots	2,054	1,657	...	1,484	1,208	...	1,561	1,035	...	1,499.8	± 159.0
Means	342.3	276.2	...	247.3	201.3	...	260.2	172.5	...	249.97	± 26.5
Lbs. per acre	4,260	3,437	...	3,078	2,505	...	3,238	2,147	...	3,111	
Percentages	136.7	110.3	...	99.3	80.7	...	104.0	69.0	...	100.00	± 10.6

These results are significant according to Fisher's Z test (1% points of distribution) as under:—

Clean weeded no shade being significant over all.

Clean weeded gliricidia shade, clean weeded banana shade and cover crop unshaded are significant over banana and gliricidia cover crop.

It is as yet too early to draw any conclusions from this experiment.

MISCELLANEOUS CROPS.

Sunn Hemp (C. Juncea).—Two new varieties of Sunn hemp, "Cawnpore 12" and "Nagpur," introduced from India, were grown in isolation plots for seed increase purposes prior to experimental fibre extractions.

Experimental fibre extractions were made from the Bukalasa variety of Sunn hemp.

Cover Crops and Green Manures.—Plots have been maintained of the undermentioned cover crops and green manures for observation and seed increase purposes:—

Centrosema pubescens, *Centrosema plumieri*, *Phaseolus calcaratus*, Bengal bean, *Dolichos lablab*, *Crotalaria juncea*, *Crotalaria intermedia*, *Crotalaria alata*, *Crotalaria agatiflora*, *Cajanus indicus*, *Cassia* spp., *Indigofera anil*, *Sesbania macrantha*.

Ginger.—A small plot of ginger yielded at the rate of 7,749 lbs. of green ginger per acre.

Jute.—A quarter-acre plot of jute was grown for seed increase purposes.

Plantains and Bananas.—Twenty-five varieties of plantains and seventeen varieties of bananas have been grown for observation purposes.

Sweet Potatoes.—Thirteen of the local varieties of sweet potatoes have been grown to ascertain their relative yielding capacities and palatability.

Miscellaneous.—Selections were made in the maize varieties, but unfortunately these were all destroyed by locusts. Selection work has also been carried out on Sunn hemp with the object of obtaining a taller plant and hence a longer fibre, on "Mutike" beans with the object of getting a strain less susceptible to leaf spot, and on sim-sim.

A. L. STEPHENS,
Plantation Manager.

ANNUAL REPORT OF THE COTTON BREEDING SECTION, 1931—32.

SECTION 1.

BUKALASA ZONE.

Staff.—The Cotton Botanist was at Bukalasa throughout the season with the exception of sundry visits to Serere.

The Assistant Cotton Botanist returned from leave during September and since then has been at Serere.

Mr. Irving, Agricultural Officer, has been at Bukalasa since the beginning of 1932 preparatory to carrying on the cotton breeding work there until the return from leave of the Cotton Botanist.

General.—No additions or alterations to the laboratory were made during the year. The question of a suitable site for a seed farm in and/or for Buganda has received consideration as there is little doubt of the necessity for a change of seed in this area as soon as possible. The possibilities of Buvuma Island have been explored by both the Cotton Botanist and the Assistant Cotton Botanist who suggested this site. Separate reports have been submitted and the conclusions reached indicate that special trials will be necessary before a decision can be made.

Meteorological.—The weather experienced during this season was inclined to extremes and this generally had a bad effect on the crop. Heavy rains caused bud shedding, and drought conditions caused boll shedding and prevented the formation of a second crop.

The experimental plots were planted at the end of June under very favourable conditions which resulted in unusually good germination. Unfortunately the ensuing weather was cool and cloudy with low soil temperatures which caused a check in growth and spread of Angular Leaf Spot. August and September were both rather cool. October commenced with a drought which checked the spread of disease and accelerated the flowering rate; unfortunately very heavy rains were experienced at the end of the month which caused considerable lodging and spread of Angular Leaf Spot. November was very dry but the heavy rains of the previous month resulted in plants going badly to wood. December commenced by being very wet with the resultant heavy shedding of buds and the further spread of disease and increase of lodging. After the 11th December practically no rain fell until the end of the season. This prolonged hot and dry spell caused rapid ripening off of the crop already formed and also a flush in flowering which was, however, almost entirely lost through boll shedding. Of the bolls which did survive many opened prematurely with the consequent production of immature lint.

Generally speaking the weather during the season was unfavourable and caused a poor crop especially on land which had been cultivated for some time. The cool moist weather caused the spread of Blackarm and apparently assisted the spread of *Lygus* which caused great damage and considerable loss of crop on old land. From the breeding point of view a bad season is of definite value as it shows up resistances and forms a very good test of new strains under the worst conditions.

Apart from affecting yield, the adverse weather affected the quality of the crop, the number of motes being unusually high and the staple being weak, owing mainly to the large quantity of immature cotton produced during the very dry spell after the middle of December.

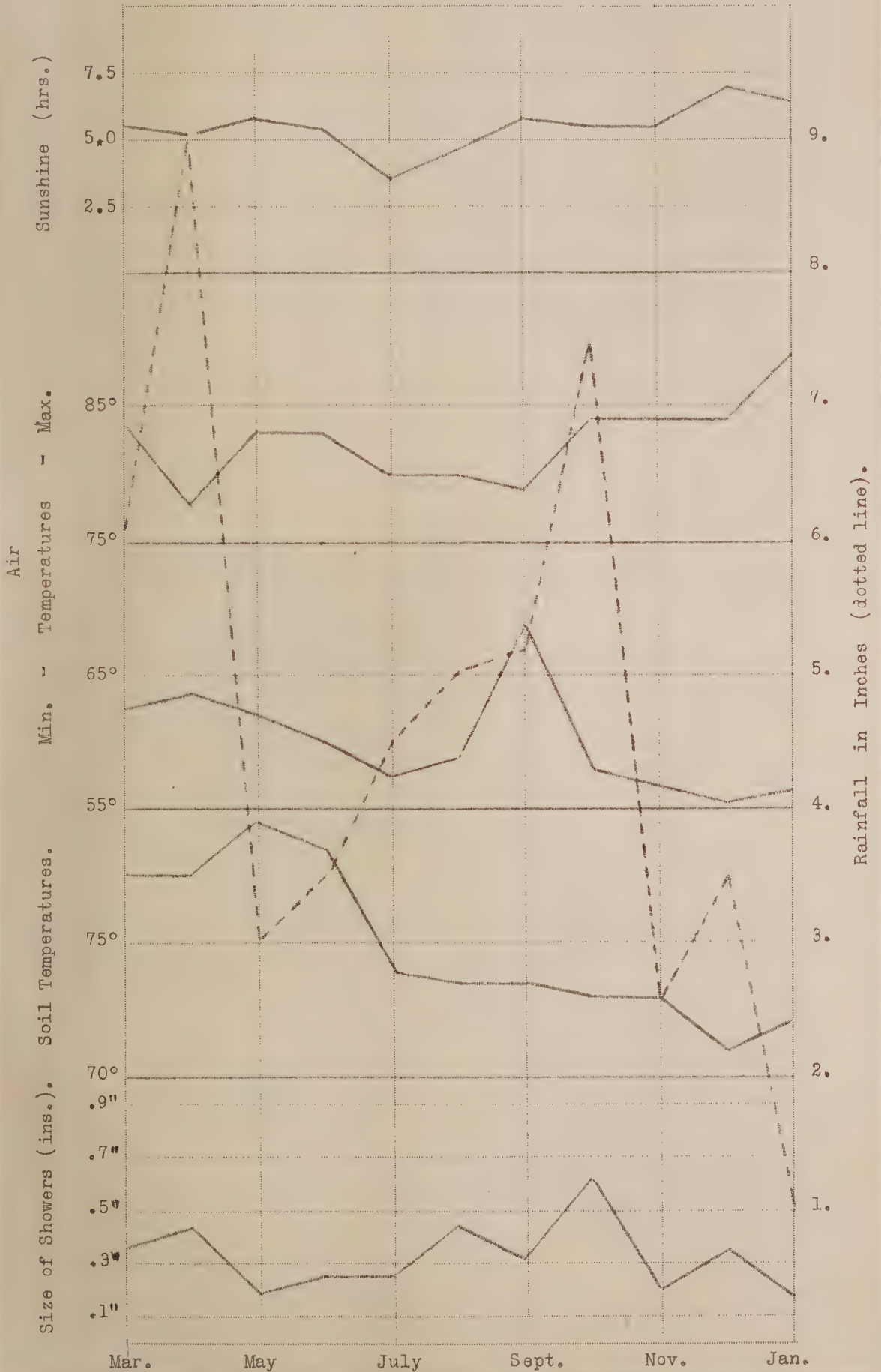
TABLE 1.
SUMMARY OF METEOROLOGICAL CONDITIONS.

Month.	Rainfall (ins.)	Deviation from 10 yr. mean.	Number of days on which rain fell.	Mean size of shower (ins.)	Mean soil temp. 6" depth.	Mean sunshine (hrs.)	Dry bulb minus wet bulb.	Mean max. temp.	Mean min. temp.
1931—March ...	5.90	+1.23	17	0.35	77.5	5.5	10.7	84.0	62.8
April ...	8.73	+2.15	20	0.44	77.1	5.2	9.9	80.0	63.1
May ...	3.10	-2.04	16	0.19	79.5	5.7	10.7	82.5	62.6
June ...	3.42	-0.18	15	0.23	78.3	5.5	12.4	83.0	60.4
July ...	4.42	+0.70	19	0.23	74.0	3.3	9.9	80.3	58.5
August ...	4.78	+0.11	11	0.43	73.3	4.9	10.6	80.3	59.0
September ...	5.29	-0.22	17	0.31	73.6	5.7	10.7	79.2	68.5
October ...	7.64	+0.54	12	0.64	73.0	5.5	12.0	83.8	58.9
November ...	2.68	-1.89	13	0.21	73.0	5.6	11.3	84.0	57.4
December ...	3.46	+0.50	10	0.35	71.0	6.9	13.3	83.7	55.4
1932—January ...	0.64	-0.59	5	0.13	72.3	6.7	19.5	88.2	56.0
February ...	1.17	-1.00	7	0.17	75.4	5.1	18.3	89.0	57.5

WEATHER.

BUKALASA. SEASON 1931-32.

Monthly Means.



SELECTION WORK.

The second breeding plot was used this season, No. 1 having been put down to a permanent cover of *Centrosema* for two years. The new plot proved fairly satisfactory although there were one or two gulleys which had to be filled in and several bad patches of soil which gave rise to considerable stunting in the early stages. Very little wash occurred on the plot even during the heavy October rains. All sections were sown on 29th June under very favourable conditions.

New Selection Series.—There were 100 families sown in this series, which included some twenty selections from Bulemezi District, 11 from U. 4 derivatives and 10 from strains which showed resistance to Blackarm in the previous season, the remainder being made up of Upland types selected in the previous season's N. S. Series.

Germination was rapid and a final stand of 96% was obtained with only two seeds per hole. About 2% of these were lost later when a swarm of locusts settled on the plot and nipped off a number of young plants.

Careful notes on Angular Leaf Spot and Blackarm infection were made throughout the season, weekly counts being made until the plants were too large for this to be done properly. The disease spread rather more slowly than last season but eventually more infection occurred owing to the October and early December rains, and Blackarm, which in the previous season was negligible, was responsible this season for considerable damage to those families which were susceptible to the disease. The following table shows the spread of infection in the plot:—

TABLE 2.
SPREAD OF ANGULAR LEAF SPOT.

Date.	Number of plants infected.	Percentage of plants infected.
August 10th	67	—
" 17th	103	—
" 25th	131	7.1
September 2nd	149	8.1
" 8th	208	11.2
" 15th	296	16.0
" 22nd	443	23.8
" 29th	579	31.2
October 6th	786	42.3
" 13th	906	48.7

After the last date in the table it was impossible to make detailed counts but by the 11th December fully 80% of the plants were infected.

Considerable variation in degrees of resistance to this disease was observed—the families B. 31/5, B. 31/10, B. 39/8, B. 39/16, S.G. 88.2.18, B66 and B95 showed complete resistance throughout the season except that after the October rains a few plants of the B. 31 group became infected with A.L.S. which, however, disappeared shortly afterwards.

There is now evidence that we have two strains and their sub-families which are definitely resistant in a high degree to Angular Leaf Spot and Blackarm; these are the B. 31 and B. 39 groups. Unfortunately neither of these are very promising yielders, as will be seen in the table giving a summary of selected plants. If attempts to select out a high yielding strain from either of these fails crossing will be attempted with a high yielding type.

U. 4 families varied considerably in resistance, three being partially resistant, while the others were definitely susceptible.

Two families selected from Cambodia originally obtained from South Africa were interesting as they showed great differences in resistance—Cambodia 29 was the first of all the N. S's to go down with the disease and eventually the plants were almost completely destroyed by Blackarm; Cambodia 5, however, showed comparative resistance until the end of October and never had more than a few Blackarm lesions on the petioles.

The most susceptible groups were B. 38 and B. 45 which have been discarded with the exception of one or two promising plants in the B. 45 group.

Ramularia was fairly wide-spread, but caused no damage beyond the shedding of a few leaves. Resistance to this disease is shown by a number of types but it is not serious enough to warrant special attention.

Lygus caused a certain amount of damage, and attempts made to find resistant families met with no real success.

The very moist conditions of early December, coupled with the excessively dry period immediately following caused considerable bud and boll shedding with the result that a poor crop was harvested. The crop came to maturity late and the picking period was very short. Very few completely sound bolls were produced with the consequence that the usual boll analysis was possible in only a comparatively few cases. The adverse weather resulted in low lint indices and in a weak staple—the latter being largely due to the large quantity of immature lint which was produced.

Families of B. 42, B. 53 and B. 54 all of which are rather early and quick maturers with erect habits yielded quite well despite the fact that they were comparatively badly attacked by Blackarm.

Two families of the U. 4 group are especially promising—U. 4.30.4 and U. 4.30.16 both yielded well and produced long and silky lint. The latter was nearly resistant to Angular Leaf Spot, while the former was inclined to be susceptible. Both strains had very high lint indices for this reason.

Very few of last season's district single plant selections proved to be of any use, the lint in most cases being short and harsh. Two—B. 66 and B. 95—showed resistance to Blackarm, and selections from these will be tested out next season.

Table 3 below summarises the quantitative characters of the more important selections made for next season's N.S. Series.

TABLE 3.
SUMMARY OF QUANTITATIVE CHARACTERS OF SOME PLANTS SELECTED FROM THE NEW SELECTIONS.

Strain.	Seeds per boll.	Motes per boll.	Lint wt. per boll. (grms.)	Lint Index.	G.O.T.	Lint length (mm).	Total sound locks produced.
B. 31.5.10	33.6	1.4	1.68	5.0	32.8	29.2	39
B. 31.6.12	30.8	1.2	1.48	4.8	30.6	30.4	50
B. 31.10.12	30.6	3.4	1.30	4.2	29.4	30.6	36
B. 37.5.18	34.2	1.8	1.99	5.8	33.1	32.7	57
B. 37.6.8.	35.2	2.0	1.53	4.4	26.2	31.1	90
B. 37.14.13	31.4	3.6	1.90	6.1	27.8	33.2	81
B. 39.8.11	32.0	3.2	1.33	4.2	25.2	33.6	90
B. 39.8.12	33.2	0.6	1.49	4.5	28.8	33.4	81
B. 39.8.16	32.4	2.2	1.47	4.5	27.1	35.0	59
B. 39.16.3	34.0	2.2	1.37	4.0	28.1	34.6	48
B. 39.16.14	34.4	1.6	1.38	4.0	25.3	33.4	51
B. 42.9.14	31.8	1.4	1.72	5.4	28.8	37.7	63
B. 42.9.18	31.2	2.0	1.75	5.6	32.1	35.5	81
B. 42.12.12	31.6	1.0	1.62	5.1	33.0	33.9	83
B. 42.12.14	34.4	2.2	1.75	5.1	31.9	36.7	68
B. 43.16.8	33.8	2.6	1.56	4.6	31.7	30.8	39
B. 45.18.9	31.6	4.0	1.72	5.4	31.1	31.8	41
B. 53.14.5	28.6	3.6	1.64	5.7	29.6	30.9	92
B. 53.19.3	32.0	3.2	1.69	5.3	33.6	30.3	40
B. 54.12.11	32.6	2.0	1.98	6.1	32.1	33.6	71
B. 54.12.16	32.0	2.8	2.04	6.4	32.7	33.3	39
U. 4.30.4.6	31.2	3.2	1.82	6.2	29.5	34.1	98
U. 4.30.4.10	31.0	1.8	2.01	6.5	32.4	30.0	70
U. 4.30.16.3	29.4	3.8	2.09	7.2	34.0	31.7	48
U. 4.30.16.19	30.0	4.6	1.98	6.5	36.1	31.3	67
B. 64 A. 7	32.4	2.8	1.88	5.8	33.0	34.9	50
B. 73.11	29.8	2.6	1.67	5.6	34.7	31.8	81
B. 96.20	31.6	2.0	1.83	5.8	34.8	31.7	88

The families of B. 31 and B. 39 have been selected mainly on account of their high resistance to Angular Leaf Spot and Blackarm.

PEDIGREE LINES.

Eighteen lines, each consisting of two rows of 25 plants, were planted on the same day as the N.S. series. Germination was excellent, a stand of 98% being obtained.

B.P. 7/31.—This was a selected bulk of B. 31, the line which showed complete resistance to Blackarm in the previous season. The resistance was maintained throughout the season, two plants becoming infected with the "spot" stage which, however, soon disappeared. The line was obviously still splitting for habit—the true habit of the line being short, squat, bushy plants with rather a large number of the lower monopodia drooping on the ground. The flowering curve did not promise a good crop and heavy boll shedding on top of this resulted in a very low yield. The staple is satisfactory but the lint is slightly harsh and the lint index is exceedingly low. Despite the low yielding character the resistance of this strain to Blackarm is a character sufficient in importance to warrant its retention. A number of selections have been made within the line for trial next season.

B.P. 8/31.—This was selected bulk of B. 42—a quick and early maturer with an erect habit. This line as a whole showed definite susceptibility to Blackarm and is unsuitable for further propagation. Selections of three very promising plants were made for next season.

B.P. 9/31 (B. 42/3).—Selected as the best yielder of B. 42. It did not get A.L.S. until late and Blackarm was very slight. It was storm resistant and in appearance far more even than B.P. 8/31. It yielded fairly well and produced good quality lint but it gave evidence of still splitting. It would appear, however, to contain useful material for further work and several selections have been made for next season.

B.P. 14/31.—A single plant selection made in a plot of S.G. 27.15.13. It showed resistance to Blackarm but lodged badly, with the consequent spoiling of a large part of the crop.

B.P. 18/31 (S.G. 23.8.6.13.7.10).—As a whole highly susceptible to Blackarm, but despite this a good crop was produced. Further work will be done on this line which is now approaching genetic purity.

B.P. 20/31 (U. 4.4.2. A.24).—A single plant selected in a line of U. 4.4.2 obtained from Barberton the previous season. Produced erect and even plants but with rather long lower sympodia. Its flowering curve reached a very high peak and it yielded better than any other line in this series. It was rather susceptible to Blackarm but nevertheless produced a good crop under conditions favourable to the spread of the disease. The staple is satisfactory but the lint index and G.O.T. are very low for U. 4. Unfortunately insufficient selfed seed was obtained for the next stage of increase. The line will be repeated in next season's P.L.'s.

B.P. 21/31 (U. 4.4.2. B. 1).—Of similar parentage to B.P. 20/31. Produced a very uniform bushy plant well clear of the ground and distinctly resistant to A.L.S. and Blackarm. Its lint characters are a distinct advance on U. 4 the staple being long and silky. The lint index and G.O.T. are again low for U. 4. The line has been bulked for increase and for trial in next year's variety trial at Bukalasa.

B.P. 23/31.—A selection from S.G. 27. It produced a woody straggling plant but flowered well. Susceptible to Blackarm and shed very badly. One promising plant was selected for further trial.

B.P. 25/31.—A selection from Delerect No. 1 (obtained from the Sudan). Proved to be very susceptible to Blackarm and shed nearly all its bolls. More storm resistant than S.G. 29 type but not as good as the U. 4 derivatives.

TABLE 4.
SUMMARISING THE QUANTITATIVE CHARACTERS OF THE ABOVE.

Line.	Seeds per boll.	Motes per boll.	Seed wt. per boll (grm.)	Lint wt. per boll. (grm.)	Lint Index.	G.O.T.	Lint length.	Total sound locks per plant.
B.P. 7/31 ...	29.8	2.7	3.34	1.42	4.8	29.8	32.9	39.2
B.P. 9/31 ..	29.6	—	3.36	1.63	5.5	32.5	32.2	44.6
B.P. 14/31 ..	30.8	2.9	3.88	1.68	5.6	29.8	33.9	32.4
B.P. 20/31 ...	30.5	2.3	3.02	1.67	5.5	35.6	31.3	72.3
B.P. 21/31 ...	28.5	3.5	2.96	1.58	5.5	34.8	32.3	44.1
B.P. 23/31 ...	31.4	2.2	3.83	1.62	5.1	29.7	34.9	33.7

REFERENCE PLOT.

Amongst the varieties under observation in the reference plot were the following:—

Ishan A.—Obtained from Nigeria. It had a high node number and was consequently late maturing. It was very susceptible to Angular Leaf Spot and Blackarm and although a large number of flowers were produced few bolls were obtained.

Red Leaved Upland.—This was grown from a plant of red leaves and bolls which appeared in a plot of Local on the plantation last season. It was remarkably true, only one off type being produced, but it yielded practically no crop at all.

Several crosses were received from the Empire Cotton Growing Corporation's Research Station in Trinidad for trial on account of their possible resistance to Blackarm. Unfortunately they all proved highly susceptible to the disease and most of them susceptible to Jassids, as a result no crop was obtained from them.

Other varieties under observation included—Acala, Arizona, Allen, Bancroft, Cambodia, Meade, Okra Leaved Upland, Segamwenge, Sea Island. None of these varieties showed any promise.

INCREASE PLOTS.

Four small bulk increase plots ($\frac{1}{4}$ -acre in area) were grown this season. U. 4 and B.P. 6/30 (selected S.G. 27) were grown on the same plot for increase purposes and also to test the possibility of saving land by growing two increase plots adjacent, planted at widely different dates. The plot of U. 4 was planted at the end of May and produced vigorous plants and an enormous number of flowers. B.P. 6/30 was planted on 12th August and as soon as the flower buds were about a week off flowering all the flowers and buds on U. 4 were pruned off to prevent any intercrossing. By this time U. 4 had set a considerable crop of bolls but unfortunately the first pruning was unnecessarily severe with the consequence that most of the young bolls were shed and a very small crop at the rate of 70 lbs. per acre was reaped. If 200 yards is taken as a minimum distance for safety an area of 32 acres is required for each quarter-acre, *i.e.*, 64 for two separate plots whereas for a half-acre plot the area required is 42 acres, a saving of 22 acres if two quarter-acres can be grown adjacently. Thus, although this season the scheme was not a definite success, it is certainly worth repeating with a less severe pruning and possibly with slightly smaller plots.

Two other segregated plots were planted with N. 3/5 (Bukalasa grown) and N. 3/5 (Serere grown) respectively in connection with the interchange of seed experiment. Seed from these two will be used in next season's variety trial.

VARIETY TRIAL, BUKALASA.

The first of the new variety trial plots was used for this experiment. This plot had not been cropped since the plantation was opened, and despite one or two rather large gulleys it proved to be very uniform. Very little wash was experienced despite a pronounced slope; this was probably due to the fact that the soil was full of vegetable matter.

The lay-out was in the form of an 8 by 8 Latin square, the sub-plots being 1/40th-acre in area.

The following varieties were planted on 10th July under very favourable conditions, the sowing rate being six seeds per hole:—

LOCAL.—Seed obtained from the nearest ginnery and consisting of a mixture of many different types of Upland.

N. 3/5.—Originally a selection made at Bukalasa by Mr. Harmsworth from Nyasaland Upland. Owing to the fact that it has not been segregated it is gradually reverting to "Local."

B. 16.—The 3rd generation of a selection made at Bukalasa in 1926 by Mr. Clay from N. 3/5.

S.G. 27.—Originally selected from Nyasaland Upland at Serere in 1924.

S.G. 27.15.13.—A grandchild of S.G. 27.

S.G. 29.—Similar in origin to S.G. 27. Generally a better strain than S.G. 27 and is now in distribution in Teso District.

S.G. 23.8.—A low boll shedding strain selected at Serere from Nyasaland Upland in 1924. It is inclined to be late maturing and is definitely susceptible to Jassid under Eastern Province conditions. It is hoped that it may prove to be a suitable type for the better soil and climatic conditions of Buganda as it has excellent spinning qualities.

U. 4.—Seed originally obtained from Mr. Parnell in South Africa, grown for two seasons in Uganda. Jassid resistant and also resistant to lodging.

Germination was rapid and the very excellent stand of 98.9% was obtained by 20th July. Unfortunately a large swarm of locusts settled on the plot at the end of July and about 1% of the young plants were nipped off by these pests. No varietal differences in germination were observed and no resowing was necessary.

Good progress was made until the end of October when the heavy rains caused considerable lodging except in the U. 4 plots. Lygus caused some damage early on but it was not nearly so severe as on old plots in other parts of the plantation.

Angular Leaf Spot counts were made at weekly intervals from the time of thinning until the plants were too large for accurate observations. A count made on 8th September gave the following results:—

TABLE 5.

Variety.	Mean number of plants infected per plot (possible 162).						Plants infected expressed as percentage of the mean.	
S.G. 27.15.13	...	...	...	96.1	...	...	...	138
Local	...	...	...	57.6	...	...	...	83
U. 4	...	...	...	124.4	...	...	...	179
S.G. 27	...	...	...	30.1	...	...	...	43
B. 16	...	...	...	21.8	...	...	...	31
N. 3/5	...	...	...	52.4	...	...	...	75
S.G. 23.8	...	...	...	107.3	...	...	...	154
S.G. 29	...	...	...	67.6	...	...	...	97
MEAN	...	...	...	69.6	...	...	...	
S.E. DIFFERENCE	...	...	...	11.4	...	...	...	16.3

The above table shows that there was considerable variation in the amount of infection at this stage, the results worked out by Fisher's methods showed significance and the following conclusions can be drawn:—B. 16 had less infection than all varieties except S.G. 27; S.G. 27 had less infection than all except B. 16 and N. 3/5; N. 3/5, Local, and S.G. 29 had less infection than S.G. 27.15.13, U. 4 and S.G. 23.8; S.G. 27.15.13 had less than U. 4 and S.G. 23.8. No difference between U. 4 and S.G. 23.8.

There is no apparent reason for the low infection of B. 16 except that it may be a resistant type although this character had not been observed previously. S.G. 27 was possibly free from infection owing to the fact that the seed was two seasons old and all the disease organisms had died off. This seed was from the worst Blackarm season in Teso, and if the death of the organisms had not occurred, heavy infection in the early stages would be expected. The high infection of U. 4 and S.G. 23.8 is noteworthy especially as in neither case was the yield affected by the disease, whereas S.G. 27 became badly infected with Blackarm, which undoubtedly reduced the yield considerably.

Flower counts were made on two consecutive days per week but the curves obtained from these figures were of little value from the point of view of crop estimation. B. 16 and U. 4 gave many more flowers than the other varieties and their position in yield was 6th and 4th respectively while S.G. 23.8 gave by far the lowest flowering rate of all and yet was best yielder with N. 3/5. Diagram II shows the flowering and picking curves of the more interesting strains. Lodging was bad in October and with the exception of U. 4 all varieties were practically laid flat with the result that a considerable quantity of cotton was lost and the percentage of fift was increased through soil staining.

The crop came to maturity late, the first picking not being made until January 1st, and the last was made on February 29th. Considerable differences in picking peaks were observed. B. 16 reached its highest peak at the second pick, N. 3/5, S.G. 23.8 and S.G. 29 reached theirs at the third pick, while Local, U. 4, S.G. 27, and S.G. 27.15.13 did not reach their peak until the sixth pick. There were two unexpected reversals of form in these results, firstly, S.G. 23.8 has previously been looked upon as being a definitely late maturer, and, secondly, U. 4 has been until now an early maturer. The fact that the whole picking season was on the late side was probably responsible for these results.

The following table shows the results obtained—the figures have been worked out on seed cotton and lint figures, but this season there is little difference between the two sets of figures:—

TABLE 6.

Variety.	Mean Seed Cotton in lbs. per 1/40th acre plot.	Yield as percentage of mean.	Mean Lint per 1/40th acre plot.	Yield Lint as percentage of mean.
N. 3/5	24.2	130	7.3	128
S.G. 23.8	23.9	129	8.0	140
Local	20.4	110	6.1	107
U. 4	18.6	101	6.1	107
S.G. 29	18.2	98	5.8	102
B. 16	17.3	94	5.0	88
S.G. 27	14.0	76	4.3	75
S.G. 27.15.13	11.3	61	3.2	56
MEAN	18.5	100	5.7	100
S.E. DIFFERENCE	1.08	5.8	0.46	8.1

These results are very significant and the following conclusions can be drawn:—

S.G. 23.8 and N. 3/5.—No difference and both significantly higher yielders than all other varieties.

Local.—Significant yield over S.G. 29, S.G. 27, B. 16 and S.G. 27.15.13.

U. 4, B. 16 and S.G. 29.—Better yielders than S.G. 27 and S.G. 27.15.13 with no differences between the three of them.

S.G. 27.—Better than S.G. 27.15.13.

The above are for the seed cotton figures.

The lint figures give the following results:—

The only differences from the seed cotton figures are that Local is not significant over S.G. 29 and that B. 16 is not significant over S.G. 27.

Considerable differences in percentage of fift were obtained. The following table gives the results which are significant by Fisher's Z test.

TABLE 7.

Variety.	Percentage of Fift.	Fift expressed as percentage of mean.
S.G. 23.8	16.8	78
N. 3/5	17.3	80
B. 16	19.4	90
Local	19.7	91
S.G. 29	22.2	102
U. 4	23.2	107
S.G. 27	25.3	117
S.G. 27.15.13	28.6	132
MEAN	21.6	100
S.E. DIFFERENCE	1.7	7.8

These figures give the following results:—

Both S.G. 23.8 and N. 5 give significantly more first quality cotton than S.G. 29, U. 4, S.G. 27 and S.G. 27.15.13.

B.16, Local.—Significantly more first quality than U. 4, S.G. 27 and S.G. 27.15.13.

U. 4.—Significantly more than S.G. 27.15.13.

Taking all the above results into consideration the most encouraging feature is the behaviour of S.G. 23.8. This strain was heavily infected with Angular Leaf Spot and yet recovered when other varieties were stricken with the disease; it again gave a low flowering rate, but its low boll shedding character enabled it to give a yield better than any variety except N. 3/5. It also again showed a low percentage of fift cotton. These results, coupled with the excellent spinning reports which have always been received on samples of this strain are sufficient to warrant an extended trial of this variety in Buganda next season.

U. 4 has not shown any superiority in yield and its quality is below the standard required in this country. It has again produced a comparatively high proportion of fift cotton. These facts, coupled with the very poor spinning reports, indicate that it is not worth proceeding with this strain as such but it is hoped that a number of very promising selections which have been made from it will prove to be of value.

The results from S.G. 27 and S.G. 27.15.13 are disappointing as they did so well last season. They are both susceptible to Blackarm, and for this reason are probably unsuitable for further propagation in this country.

FLOWERING AND PICKING CURVES.

These curves are taken from the flowering and picking records of the variety trial. Five varieties are represented. The flowering curves are plotted from the plot means of counts made on two consecutive days weekly; the yield curves from the plot means of weekly picks.

The most noteworthy feature is the low rate of boll shedding exhibited by S.G. 23/8 as shown by its low flowering and high picking curves. U. 4 on the other hand shows an abnormally high rate of shedding when a similar comparison is made.

Differences in the date of maturity are observable in the yield curves, the main peaks of B. 16 and Local are one week ahead of those of S.G. 23/8 and S.G. 29, indicating their shorter maturation period. U. 4 comes a late last, its yield curve rising to a main peak three weeks later.

Yield, lbs. of seed cotton.

4.

3.

2.

1.

Picking Curves.

Yield/plot/week.

BUKALASA.

VARIETY TRIAL.

Flowering Curves.

Flowers/plot/week.

175.

150.

125.

100.

75.

50.

25.

Flowers per plot.

S.G.23/8

B. 16.

U. 4.

S.G.29

Local

KEY

—

- - -

+

+

+

+

+

26th Feb.

1st Jan.

Weekly Intervals

19th Nov.

9th Oct.

The strain B. 16 was disappointing as it produced a large number of flowers and has a very nice style of lint. Its failure must be attributed to heavy boll shedding caused by adverse weather conditions, and not to Blackarm, which did not severely attack this particular strain.

The following table gives a summary of the quantitative characters of these varieties.

TABLE 7 (a).

Variety.	Lint Length. mm.	Lint index.	Wt. of 100 seeds (grms).	G.O.T.	Local Graders' order of merit.
S.G. 23.8	31.1 ± 0.16	5.5	10.5	33.6	7
N. 3/5	30.9 ± 0.21	5.2	11.7	30.1	5
S.G. 27	30.4 ± 0.18	5.0	11.5	30.5	3
S.G. 27.15.13	31.1 ± 0.21	5.4	12.9	28.5	2
Local	29.7 ± 0.23	5.3	11.3	30.0	6
B. 16	33.1 ± 0.21	5.0	12.5	29.0	1
U. 4	28.3 ± 0.22	5.3	10.4	33.6	8
S.G. 29	30.4 ± 0.18	5.7	12.0	32.0	3

The correlation between low seed weight and high ginning outturn is very noticeable—S.G. 23.8 and U. 4 both have a high ginning outturn and a low seed weight while B. 16 and S.G. 27.15.13 having a high seed weight give a low outturn. The main exception to this is S.G. 29 which has both high, the high ginning outturn in this case being due to a high lint index. There are few differences in staple length except that B. 16 is very much longer than any other variety while as usual U. 4 is the shortest. It is noticeable that Local is the most irregular sample.

INTERCHANGE OF SEED EXPERIMENT.

The object of this experiment is to ascertain whether growing Bukalasa selected seed at Serere and bringing it back into its original environment has any temporary effect on the plant. This information was required in connection with the possibility of one seed farm being sufficient for the whole Protectorate.

The experiment was carried out at Bukalasa and the reverse was repeated at Serere. The following "varieties" were planted, the lay-out in each case being a 6 by 6 Latin square:—

At Bukalasa:—

- U. 4.—(Serere origin—once grown Bukalasa).
- U. 4.—(Serere origin—Serere grown).
- N. 3/5.—(Bukalasa origin—Bukalasa grown).
- N. 3/5.—(Bukalasa origin—Serere grown).
- S.G. 23.8.—(Serere origin—Serere grown).
- S.G. 23.8.—(Serere origin—Bukalasa grown).

The experiment at Serere was similar and is discussed separately below.

At Bukalasa the plots were sown in the first week in July under favourable conditions. The plot used was old land and in parts liable to waterlogging. Germination was fair and a count made on 23rd July gave the following figures:—

TABLE 8.

Variety.	Blanks per plot. Possible 135.	Percentage Stand.
U. 4 (Serere)	38.5	71.5
U. 4 (Bukalasa)	22.5	83.4
N. 3/5 (Serere)	29.0	78.6
N. 3/5 (Bukalasa)	23.8	82.4
S.G. 23.8 (Serere)	33.9	75.0
S.G. 23.8 (Bukalasa)	23.5	82.6
S.E. Difference	3.4	—

Seed of Bukalasa origin, irrespective of variety, gave mean blanks per plot of 23.7 against those of Serere 33.7.

These figures satisfy the "Z" test and give the following results:—

- U. 4. (Bukalasa) gave a better stand than any of the three varieties of Serere origin.
- N. 3/5 (Bukalasa) gave a better stand than U. 4 (Serere) and S.G. 23.8 (Serere) and nearly N. 3/5 (Serere).

S.G. 23.8 (Bukalasa) gave a better stand than all the Serere varieties.

No difference between the three Bukalasa varieties.

N. 3/5 (Serere) gives a better stand than U. 4 (Serere).

Bukalasa origin are significantly better germinators than those of Serere origin irrespective of variety.

There is no difference between varieties irrespective of origin.

The conclusions from the above are that Bukalasa grown seed germinates better than Serere grown seed brought to Bukalasa.

Angular Leaf Spot counts were made at weekly intervals until the plants were too large for accurate observations. A count made on 27th August gave the following figures:—

TABLE 9.

Variety.	Number of plants infected A.L.S.
U. 4. Bukalasa	78.3
" Serere	36.9
S. G. 23.8 Bukalasa	69.4
" " Serere	49.8
N. 3/5 Bukalasa	17.5
" " Serere	30.3
S. E. Diff.	29.5

These results were just significant by the "Z" test and show that U. 4 Bukalasa has a higher amount of infection than N. 3/5 Bukalasa.

Further analysis of the results, taking into consideration interaction between variety and place of origin, indicate that growing a variety out of its environment for a season and then bringing it back to the original environment has the effect of increasing the primary infection of Angular Leaf Spot; a possible explanation being that during the season out of its environment a variety is weakened and becomes attacked by Angular Leaf Spot to a greater extent than when grown in its own environment—the outside of the seed would become more infected with the disease and this would show up in the amount of primary infection in the plants when brought back to their place of origin.

The picking curves gave two peaks, the highest for all varieties occurring on 4th February. The experiment gave a very poor yield indeed owing mainly to the ravages of *Lygus* which appears to be worst on old soils. All varieties were equally attacked and the amount of buds shed due to this pest was enormous. Blackarm occurred in every variety but did not do a very great amount of damage.

The final yields were as follows:—

TABLE 10.

<i>Variety.</i>							<i>Mean yield per plot. Plot = 1/49th acre. lbs.</i>
N. 3/5 (Serere)	...	...	...	...	...	...	5.3
N. 3/5 (Bukalasa)	...	...	...	...	...	...	5.3
S.G. 23.8 (Serere)	...	...	...	...	...	...	5.1
S.G. 23.8 (Bukalasa)	...	...	...	...	...	...	5.5
U. 4 (Serere)	...	...	...	...	...	...	4.0
U. 4 (Bukalasa)	...	...	...	...	...	...	4.7

These results showed no significance—this may be due to the fact that the yields were very low, being just 200 lbs. to the acre, but it is more likely that no effect on yield occurs by this change over of seed.

The experiment was repeated at Serere in exactly the same way, although it was impossible to obtain any figures for Angular Leaf Spot infection. The germination figures were much higher than at Bukalasa, but in every case the same result was obtained, Bukalasa seed giving higher germination percentage than Serere grown seed. The final stand count was as follows:—

TABLE 11.

<i>Variety.</i>							<i>Percentage stand.</i>
S.G. 23.8 (Serere)	...	...	...	...	...	...	85.5
S.G. 23.8 (Bukalasa)	...	...	...	...	...	...	91.5
N. 3/5 (Serere)	...	...	...	...	...	...	80.5
N. 3/5 (Bukalasa)	...	...	...	...	...	...	85.8
U. 4 (Serere)	...	...	...	...	...	...	78.8
U. 4 (Bukalasa)	...	...	...	...	...	...	92.5

The more equable climate at Bukalasa would seem to have a beneficial effect on the vitality of the seed.

The yields were higher than those obtained at Bukalasa and significance was obtained, the results being as follows:—

TABLE 12.

<i>Variety.</i>							<i>Mean yield per plot.</i>
S.G. 23.8 (Serere)	...	...	...	...	...	...	6.75
S.G. 23.8 (Bukalasa)	...	...	...	...	...	...	6.35
U. 4 (Serere)	...	...	...	...	...	...	8.60
U. 4 (Bukalasa)	...	...	...	...	...	...	8.45
N. 3/5 (Serere)	...	...	...	...	...	...	6.73
N. 3/5 (Bukalasa)	...	...	...	...	...	...	9.67
S.E. Diff.	...	...	...	...	...	...	0.64

<i>Variety.</i>							<i>Mean yield per plot.</i>
S.G. 23.8	...	...	...	...	...	...	6.55
U. 4	...	...	...	...	...	...	8.53
N. 3/5	...	...	...	...	...	...	8.20
S.E. Diff.	...	...	...	...	...	...	0.91

These results are significant and give the following conclusions:—

N. 3/5 (Bukalasa) gave a better yield than any other variety.

No significance between Bukalasa and Serere in respect of U. 4 and S.G. 23.8.

S.G. 23.8 gave a significantly lower yield than either of the other varieties irrespective of origin of seed.

The interaction between variety and origin of seed is significant and N. 3/5 appears to have deteriorated as a result of having been grown once at Serere.

The general conclusions which can be drawn from this experiment at present are as follows: No effect on the yield appears to occur by growing a variety out of its environment for one year and then bringing it back again the next year. On the other hand it appears that transferring a variety has the effect of temporarily lowering its resistance to Angular Leaf Spot, and this shows up in the amount of primary infection the next session. A further result of

interest but not of direct bearing on the experiment is the better germination from seed from Bukalasa than at Serere. The effect, if any, on quality is not yet available, but as soon as all the data have been obtained a separate report on the experiment will be submitted. For the coming season the last one of this scheme the programme as laid down in my No. 29/21 of 26th June, 1930, will be carried out.

OUTSIDE VARIETY TRIALS.

It was only found possible to obtain sites for outside variety trials in Buganda very late in the season with the consequence that the actual situations of the trials were not as a whole very satisfactory and planting was very late.

Trials were laid down at Nakifuma, Nakyesunga, Mpigi and Nkosi. Unfortunately at the last three centres very dry conditions were experienced shortly after planting with the result that germination was very poor indeed and from the point of view of yield trials they were a complete failure. The trial at Nakifuma, however, gave a very satisfactory stand and a very high yield, especially when it is considered that the plots were planted in the middle of August. The yields were as follows.

Variety.							Yield in lbs. per 1/40th-acre plot.
S.G. 27	...	...	...	...	...	...	30.2
S.G. 29	...	...	...	...	...	...	31.8
Local	...	...	...	...	...	...	33.0

These yields are equivalent to over 1,200 lbs. per acre. These results were not significant. The lint from all samples was good.

Thanks are due to the Administration and to the Chiefs concerned for their willing co-operation and assistance in the carrying out of these experiments.

SPINNING TESTS, 1930—31 CROP.

The Empire Cotton Growing Corporation again very kindly arranged for these tests to be carried out and our thanks are due to them and to Messrs. Wolstenhome and Holland for grading the samples and to the Shirley Institute for carrying out the spinning tests.

The following extracts from the spinning report are of interest—"Taking both appearance and strength into consideration S.G. 23.8 Bukalasa and Serere are the best samples U. 4 is definitely the least satisfactory in all three localities, the 50s yarn for this strain being the poorest in appearance—at 30s it was more successful."

The most interesting results of the above report are the excellent yarns produced by S.G. 23.8 which has now come out top in every spinning test in which it has been included. As mentioned before this strain is useless in the Eastern Province but it may prove of great value in Buganda.

The table 13 below summarises the results. Local Bukalasa is poor at the higher counts probably owing to its mixed character. The behaviour of S.G. 29 is extraordinary as at 50s it gives a very weak yarn while at the higher counts it gives a yarn as strong as any of the others except S.G. 23.8. The superiority of S.G. 23.8 over Local is clearly shown by the Count Strength product. The Brokers Valuations again do not correspond with the spinning test results, the value of S.G. 23.8 being missed particularly at Serere.

Table 14 gives a summary of the measurable characters of these lint samples. Several interesting points crop up in this—firstly, they show clearly the correlation between low hair weight per centimetre and strong yarns, S.G. 23.8 giving the strongest yarn has the lowest hair weight while U. 4 giving the weakest yarns has the highest hair weight. S.G. 23.8 is classed as being the shortest cotton, shorter even than U. 4, and yet it has given the best yarn of any—this is a very striking example of Ball's contention that other things being equal there is no reason why a short cotton should not produce as good a yarn as a long one.

Place effect is noticeable in these results—the Bukalasa samples are generally longer than the same varieties grown at Serere and in every case the Bukalasa grown sample has a lower hair weight per centimetre than the Serere sample—it is, however, possible that this difference is due to a greater percentage of dead hair in the Bukalasa samples.

S.G. 29 is remarkably long at both centres but its length is not correlated with a low hair weight, and consequently it did not show up as well as expected in the spinning tests.

S.G. 27.15.13 promises well, despite its high immaturity count at Bukalasa, but its behaviour in this season's variety trial has condemned it.

TABLE 13.

SUMMARISING RESULTS OF SPINNING AND BROKERS REPORTS ON 1930—31 SAMPLES.

Variety.	BUKALASA.								Brokers' valuation points on	SERERE.								Brokers' valuation points on
	Lea Strength at				Count x Lea Strength at					Lea Strength at				Count x Lea Strength at				
	40s	50s	60s	70s	40s	50s	60s	70s		40s	50s	60s	70s	40s	50s	60s	70s	
S.G. 23.8 ...	65.9	49.1	41.6	31.4	2,649	2,406	2,459	2,323	125	71.5	53.6	37.7	29.0	2,903	2,594	2,345	2,079	75
Local ...	—	38.0	29.7	23.9	—	1,999	1,835	1,649	120	—	41.2	35.1	27.5	—	2,115	1,990	1,848	110
N. 3/5 ...	—	38.8	33.3	28.5	—	1,953	1,915	1,791	135	—	49.3	36.0	28.5	—	2,123	2,059	1,908	125
U. 4 ...	—	35.4	—	—	—	1,879	—	—	105	—	39.9	—	—	—	1,753	—	—	75
S.G. 27.15.13	—	41.0	29.4	25.3	—	2,063	1,840	1,736	175	—	40.3	32.3	25.1	—	2,064	1,935	1,767	125
S.G. 29 ...	—	35.7	31.2	26.6	—	1,810	1,906	1,822	135	—	35.1	31.4	26.0	+	1,980	1,931	1,807	120
S.G. 27 ...	—	40.0	32.0	24.7	—	2,080	1,894	1,734	140	—	40.1	29.9	22.7	+	2,045	1,851	1,675	125

TABLE 14.
SUMMARISING MEASURABLE CHARACTERS OF LINT SAMPLES 1930—31.

Variety.	Origin.	Most frequent hair length.	Mean hair length.	Hair wt. per cm.	Immaturity.	
					Percentage normal.	Percentage dead.
N. 3/5	Bukalasa Serere	1-1/8th full	mm. 26'4	mgm. 0'00163	68	12
		1-3/16th bare	26'4	0'00165	68	11
S.G. 23.8	Bukalasa Serere	1-1/8th	24'2	0'00147	56	14
		1-1/8th	25'1	0'00158	76	6
U. 4	Bukalasa Serere	1-1/8th	24'9	0'00166	63	12
		1-1/16th full	25'4	0'00187	57	15
Local	Bukalasa Serere	1-3/16th full	26'0	0'00158	58	13
		1-3/16th full	25'9	0'00168	65	11
S.G. 29	Bukalasa Serere	1-5/16th bare	27'8	0'00161	57	15
		1 $\frac{1}{4}$	27'0	0'00162	60	12
S.G. 27.15.13	Bukalasa Serere	1 $\frac{1}{4}$	27'5	0'00147	45	21
		1-3/16th full	26'5	0'00157	56	14
S.G. 27	Bukalasa Serere	1 $\frac{1}{4}$ full	28'6	0'00164	54	14
		1-3/16th full	26'4	0'00171	60	12

LABORATORY WORK.

In addition to the usual routine work in the laboratory in connection with the breeding work and examination of samples, an investigation into our methods of sampling for lint lengths, lint indices, and ginning outturns was started. The investigation is as yet incomplete, but preliminary results indicate that at least 100 seeds should be combed from a sample of seed cotton and from $\frac{1}{4}$ lb. to $\frac{1}{2}$ lb. used for ginning outturns, while for lint index and seed weight 500 seeds are needed.

A certain amount of work was done on immaturity counts of different varieties.

VISITORS.

During the season the Laboratory and Experimental plots were visited by the Uganda Planters Association, the Uganda Cotton Association, and the Chamber of Commerce.

G. W. NYE,
Cotton Botanist.

SECTION 2.

SERERE ZONE.

METEOROLOGICAL CONDITIONS, 1931—32.

As at Bukalasa, the season was one of extremes. The rainfall for the period May to August inclusive, totalled 2.08 inches above the eleven year mean. The period September to November totalled 3.89 inches below the mean. December gave a total of 1.00 inches above average, although the last three weeks of this month showed no rain at all. January was entirely devoid of rain, and February was slightly drier than usual.

The result of this irregular rainfall distribution was disastrous to the general crop in those parts of the Eastern Province lying north of Lake Kioga. The general grade was extremely bad, due to a larger proportion of fifi than usual, and the natural unwillingness of the natives to picking over their cotton too well. At Mulondo, where we have some control over the grade, eight times as much fifi was bought as compared with last year, although the total crop was smaller by half a lakh.

On examining the appended table, summarising the weather conditions and their correlation with Blackarm and Jassid incidence, we can see that the three periods, May—August, the month of October, and the dry weather subsequent to December 9th, are responsible for the reduction of yield and lowering of the general quality and grade as compared with last season (1930—31).

The wet period of May to August caused rapid spread of Angular Leaf Spot in the early stages of the crop. The drought experienced in October checked the Angular Leaf Spot, but brought on Jassids in large numbers. In the writer's monthly report for the month of October, he wrote "The dry conditions coming immediately on top of a severe infection of Angular Leaf Spot, coupled with the heavy Jassid infestation, will cause a marked reduction in yield over last season, unless conditions become very favourable for a 'second' crop." In actual fact the period December 9th to February 9th was totally devoid of rain; consequently the second flowering peak was useless, even the flowers themselves were small and poorly developed. The average yield for Teso district in the 1930—31 season was 330 lbs. per acre, as compared with 178 lbs. per acre for the season under review.

SERERE, 1931 SEASON. WEATHER CONDITIONS.

Month.	Rainfall.	Sunshine.	Soil temps.	Remarks and Diseases.
May ...	0'40 ins. above average.	Much above average.	About average.	—
June ..	0'08 ins. below average.	Slightly above average.	About average.	—
July ...	1'02 ins. above average.	Well below average.	Well below average.	Ideal for spread of Angular Leaf Spot.
August ...	0'74 ins. above average.	do	do	do do
September ...	0'26 ins. below average.	Slightly below average.	Below average.	80% infection of ALS.
October ...	3'47 ins. below average.	Well above average.	Highest yet recorded.	ALS slightly higher at beginning of month. Checked later. Jassid nymphs in very large numbers seen on Oct. 12th.
November ...	0'16 ins. below average.	Below average.	Much above average.	Blackarm lesions increased rapidly at the end of the month. Adult Jassids quite numerous.
December ...	1'00 ins. above average. Very dry for last three-quarters of the month.	Above average.	Above average.	Lesions increased to about 70% as result of very wet period in late Nov.—early Dec. Jassids increased again at the end of the month.

DISEASES AND PESTS.

Bacterium malvacearum.—Mention has already been made of this disease in the section dealing with the weather conditions. Further references appear under the headings "Breeding Plot" and "Rothamstead Blackarm Experiment."

In general one can say that this disease was rather more serious in the northern parts of the Eastern Province than last year, but it was not nearly so bad as in the 1929-30 season, when the average yield of Teso district was about 50 lbs. per acre.

Jassids.—Vide section dealing with weather conditions. The dry spell in October coincided with the appearance of an enormous number of nymphs. By the time the true dry season had set in, there was marked reddening of the leaves of the more susceptible strains. S.G. 23.8, which broke down under Jassid last season, again showed marked susceptibility.

Helopeltis bergrothi.—This pest appears to be on the increase. In parts of the Lango district (Aduku area in particular) and the Northern Province (notably the Pader district of Chua) large areas suffered serious damage from this insect. In extreme cases, plots could have given next to no yield. The internodes were shortened, the plants bearing a "loggerhead" appearance, and there were marked scars on the stems and branches. Flowering was nearly negligible; actually, there were extremely few flower buds laid down, and the low flowering rate does not seem to be due to excessive bud shedding. Presumably the C/N ratio of the infested plants is lowered. The disease appears to have originated in Busoga, but with the exception of the Buyende area, which was badly infested, there was little or no signs of this insect doing any damage. At Serere, isolated plants showed varying degrees of damage, but it was not widespread on the experimental farm.

Lygus vosseleri.—The leaf perforation which appears annually, and which is reputed to be due to the effects of this insect, was again general at Serere. This perforation first appeared in July, but by late September the majority of the plants had grown out of this condition, as they have always done before. This insect seems to cause most damage to the cotton plants when they are producing leaves at the maximum rate. In extreme cases this causes the growth rate to slow up very perceptibly. The amount of leaf area lost to the plant during one of the most critical stages of its growth is considerable.

So far no resistance, or apparent difference in the intensity of the attack, has been shown in the Breeding Plot. The insect seems to attack all strains indiscriminately. Throughout Teso adults could be found in the apical buds during August and September in almost any plot.

Spiny Boll Worm (Earias spp.).—In several localities of the Eastern Province—notably parts of Kumi County—large numbers of plants were topped when about eighteen inches to two feet high. It is difficult to estimate the amount of damage done to buds and young bolls. Towards the latter part of the first flowering peak, few boll worms were to be found at Serere.

Ramularia Leaf Mildew.—This appeared during the wet period in August, but disappeared completely during October. There seems to have been no leaf shedding from this cause.

Stainers.—Dysdercus spp. were rather more numerous than usual, with the result that there was a high proportion of cotton showing the typical yellow stain of *Nematospora*.

THE BREEDING PLOT.

This was again divided into two sections, the New Selection Series and the Pedigree Lines. The families included in the former group were either single plant selections, or single plants taken from the same group in the previous year. When a strain shows uniformity for commercial characters it then goes to the Pedigree Line group.

The fifty-one strains of the New Selection Series and the eight strains of the Pedigree Line Series were planted on July 4th, 1931, and were resown on July 16th. A very satisfactory stand was obtained.

New Selections.—On October 24th every plant of the new selections was examined for Angular Leaf Spot disease; this was repeated on November 19th. At the first count only six of the fifty-one rows showed less than 75% of plants attacked, and at the second count, five rows still showed less than 75% of plants attacked.

TABLE.

PERCENTAGE OF PLANTS ATTACKED BY ANGULAR LEAF SPOT DISEASE.

Strain.	Oct. 24th.			Nov. 19th.		
S.G. 129.2	...	...	36.8	...	...	42.2
S.G. 129.4	...	...	50.0	...	...	61.1
S.G. 129.9	...	...	47.4	...	...	47.4
S.G. 85.18.9	...	...	63.2	...	...	73.7
S.G. 88.1.2	...	...	40.0	...	...	54.9
S.G. 93.A.10	...	...	55.6	...	...	82.4
Remainder	...	...	75% or over	...	...	95—100%

Dividing the strains into family groups, the following family means were obtained:—

TABLE.

PERCENTAGE OF PLANTS ATTACKED BY ANGULAR LEAF SPOT DISEASE.

Family.	Oct. 24th.			Nov. 19th.		
S.G. 129	...	...	44.7	...	...	50.0
S.G. 85	...	...	78.9	...	...	86.8
S.G. 88	...	...	78.0	...	...	80.7
S.G. 93.A.	...	...	77.2	...	...	85.7

The remaining families of the new selections showed anything from 95% to 100% on November 19th.

The plants, which were free from all signs of Blackarm on November 19th, remained free till the end of the picking period.

The numbers of such plants were as follows:—

Strain.	No. of plants entirely free from any form of Blackarm disease.			As a percentage of the total plants in each strain.		
S.G. 129.9	...	...	8	...	...	42.1
S.G. 129.4	...	...	6	...	...	33.3
S.G. 129.2	...	...	6	...	...	31.6
S.G. 88.1.2	...	...	5	...	...	25.0
S.G. 85.18.9	...	...	4	...	...	21.0
S.G. 88.4.9	...	...	2	...	...	12.5
S.G. 93.A.10	...	...	2	...	...	11.8
S.G. 88.1.7	...	...	2	...	...	11.1
S.G. 88.2.5	...	...	2	...	...	10.5

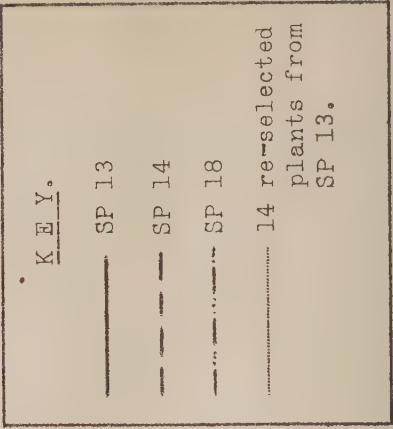
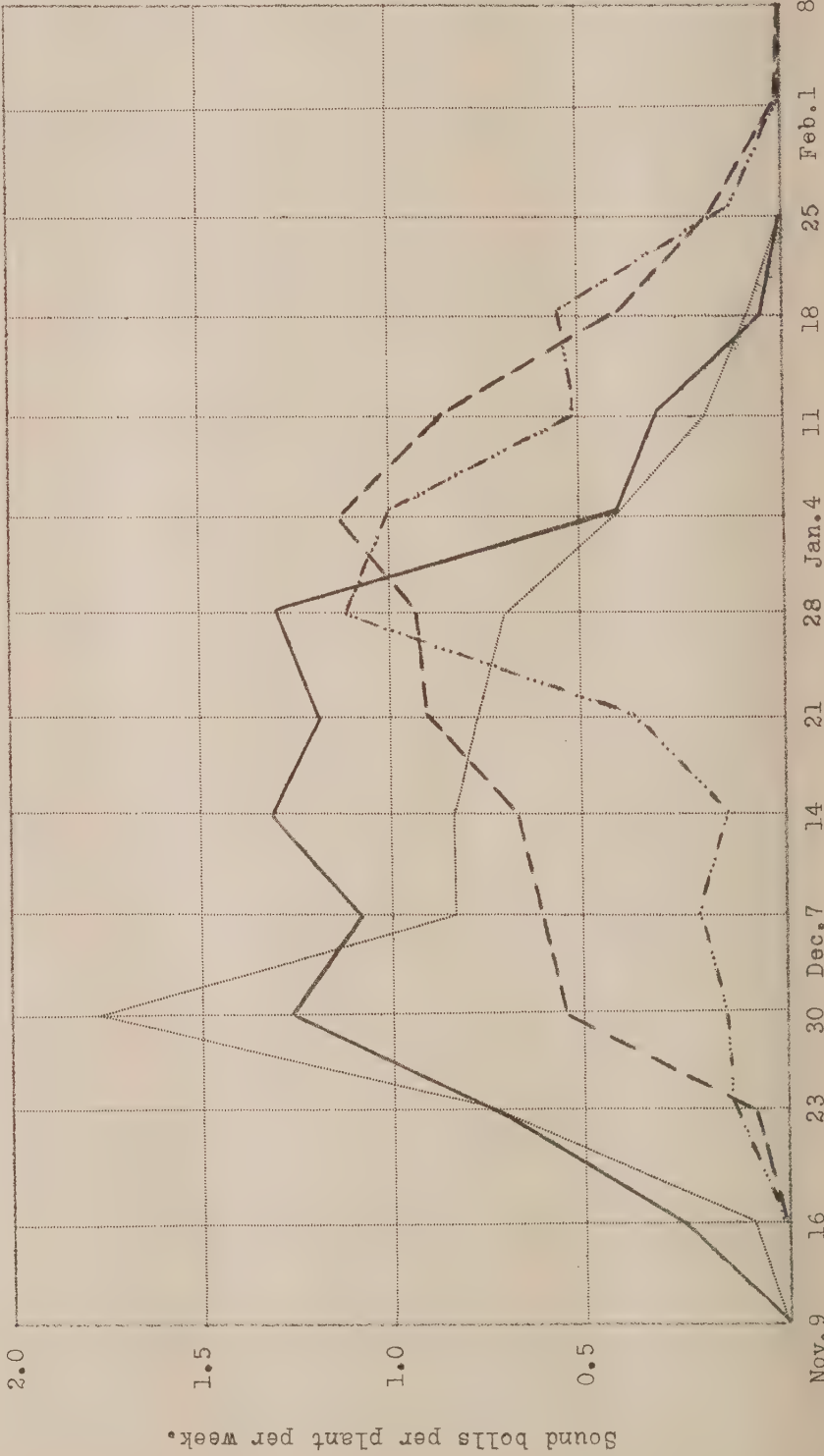
In all, only 40 plants out of about 900 showed entire freedom from any form of Blackarm. All these plants are being continued with next year.

The S.G. 129 group was outstanding; eleven plants being returned to the new selection series, and three will go into the pedigree lines. The behaviour of these will be watched with interest. The original plant was selected by the writer at Nariama during the bad Blackarm year of 1929—30.

Last season, in the new selections, the S.G. 129 row gave the highest number of resistant plants. The lint length of the selections is well up to the standard required, and the yields of the individual plants are distinctly above average. According to local opinions, the quality of the lint is very satisfactory. The only fault to be found at present is the habit, which is bad. The plants are very vigorous and are inclined to get laid; the monopodia are large and are typical of the Nyasaland Upland.

PEDIGREE LINES.

Sound bolls per plant per week.



It can be seen from these curves that SP 13 gave 5.68 sound bolls per plant prior to December 21st. SP 18, on the other hand, only produced 1.03 sound bolls per plant in the same period.

Selection inside SP 13 gave an earlier maturing set of plants than the original strain.

The curve for SP 19 follows that of SP 18 very closely.

PROMISING RE-SELECTIONS FROM THE NEW SELECTION SERIES.

Number.	Total Bolls.	Good Bolls.	Seeds/ boll.	Motes/ boll.	Lint wt./boll. gms.	Lint Length. mm.	G.O.T. %	Remarks.
S.G. 129.2.3	48	16	32.7	1.7	1.41	30.0	35.1	All very resistant to Blackarm. Originated from the Nariama selection 29-30.
S.G. 129.2.18	21	12	34.4	1.5	1.50	32.6	29.9	
S.G. 129.2.12	20	15	35.0	0.4	1.61	31.1	33.4	
S.G. 129.2.19	41	16	31.9	1.4	1.75	30.8	35.5	
S.G. 129.4.16	48	30	33.4	2.1	1.76	30.5	32.6	
S.G. 129.4.20	30	15	33.6	4.0	1.93	32.5	34.0	
S.G. 132.3.3	71	13	37.0	1.3	1.77	31.7	33.4	From Cambodia. All very resistant to Jassid. Show good recovery from Blackarm.
S.G. 132.3.9	26	15	40.3	2.0	2.07	30.8	35.7	
S.G. 132.3.11	39	16	38.7	2.9	2.10	31.7	36.0	
S.G. 132.3.16	37	22	36.4	2.1	2.09	29.9	37.3	
S.G. 132.3.18	79	28	39.1	1.6	2.17	30.0	35.6	

Those plants with their numbers underlined are being placed in the Pedigree Lines in 1932—33.

Pedigree Lines.—Blackarm counts were made on October 24th and November 11th in this series, with the following results:—

PERCENTAGE PLANTS ATTACKED BY ANGULAR LEAF SPOT.

Strain.	Oct. 24th.	Nov. 11th.
SP. 12	34.1	100.0
SP. 13	40.9	95.4
SP. 14	53.5	95.3
SP. 17	60.9	100.0
SP. 18	70.7	100.0
SP. 19	73.3	100.0

These results are interesting, as they show the intensity of the attack. SP. 13 and SP. 14 showed slightly more resistance, in the early stage, than the remainder.

Jassid counts were made on the above strains on November 29th.

Mean Jassid nymphs per leaf per plant
(10 leaves counted on each plant).

SP. 12	0.26
SP. 13	0.13
SP. 14	0.46
SP. 17	0.76
SP. 18	0.29
SP. 19	0.25

From these figures one would imagine that SP. 13 showed more resistance to Jassids than the other strains, and in actual fact it stayed greener than the remainder till the end of the season.

ANALYSIS OF THE MEASURABLE CHARACTERS OF THE MORE PROMISING OF THE 1931—32 PEDIGREE LINES.

Strain.	Flowers/ plant.	Total bolls/ plant.	Good bolls/ plant.	Seeds/ boll.	Motes/ boll.	Lint wt./ boll gms.	Lint length mm.	G.O.T. %	Lint Index.	Remarks.
SP. 13	50.1	14.98	7.93	29.3	2.0	1.73	29.16	39.4	5.90	From U. 4.4.2. of Mr. Parnell. SP. 13 very Jassid resistant.
14 selected plants from SP. 13	—	13.57	6.50	29.1	2.2	1.65	30.63	38.5	5.68	
SP. 14	51.2	15.55	6.38	31.5	1.8	1.64	30.60	36.1	5.20	Good habit.
SP. 17	70.3	12.56	4.69	30.6	3.8	1.78	31.74	34.7	5.82	From S.G. 27. Bad habit.
SP. 18	79.5	12.68	4.46	31.7	3.7	1.84	32.85	33.2	5.81	
SP. 19	67.3	12.40	3.38	31.5	2.6	1.98	31.73	35.4	6.30	From S.G. 29. Bad habit.

PEDIGREE LINES.

	Mean effective flowers per plant.	Mean bolls per plant.	Mean good bolls per plant.	Percentage shedding of flowers and bolls.	Calculated yield of lint per plant. Gms.
SP. 13	48.4	8.24	3.76	83	5.34
SP. 13	50.1	14.98	7.93	70	13.72
SP. 14	51.2	15.55	6.38	70	10.46
SP. 17	70.3	12.56	4.69	82	8.35
SP. 18	79.5	12.68	4.46	84	8.21
SP. 19	67.3	12.40	3.38	82	6.69

The related strains SP. 13 and SP. 14 gave very similar figures (both come from Parnell's U 4.4.2) although they were markedly different in habit. SP. 13 is a small compact plant, while SP. 14 is larger. SP. 17 and SP. 18 come from S.G. 27, while SP. 19 comes from S.G. 29. According to the local opinions the lint of these three is infinitely superior to that of SP. 13 and SP. 14; in fact it is doubtful whether it is worth while continuing with the two high yielding strains until their characters can be improved up to the standard required for East African cottons. It should be noted in passing that the lint of these two strains shows a very marked improvement on that of the U 4 bulk; but it is still not good enough. It is shorter and harsher on the pull than the S.G. 27 and S.G. 29 derivatives.

THE BLACKARM EXPERIMENT, SERERE.

While the writer was on leave during 1931, the following experiment was decided upon in conjunction with Dr. R. A. Fisher and R. H. Stoughton of the Rothamsted Station.

A 4 by 4 Latin square with 1/40th-acre plots sown at a spacing of 3 ft. by 3 ft. was utilised. The plots were square in shape. If a normal spacing was used, varying wind directions would have different effects on the spread of the disease. Four seed treatments were used, *i.e.* :—

1. Control—ordinary seed untreated.
2. Seed steeped in a heavy emulsion of the pure culture of the organism. This was done with a vacuum pump to ensure proper inoculation of the fuzz hairs.
3. Seed completely de-fuzzed in concentrated sulphuric acid for one hour, and then further treated with mercuric chloride under the vacuum pump, and then dried as rapidly as possible.
4. Seed dusted with a mercuric dust.

Owing to a mistake, the lay-out as planted was an "arranged" chess-board, although the officer who drew the positions of the treatments was under the impression that he had drawn a true Latin square. The full results will not be included here as they will probably be included in the Mycologist's Annual Report at a later date. The Mycologist carried out an exactly similar experiment during the same period at Kampala.

The purposes of these experiments were twofold; to ascertain the effect of seed disinfection on the amount of primary infection, and whether this is reflected in the final yields; also to try and determine the meteorological conditions which hasten secondary spread of the disease. Owing to lack of instruments it was not possible to record any observations on force and direction of the wind during rainstorms and showers. However, it was possible to determine the average rate of fall during each shower from the Casella Siphon Rain Recorder charts.

The experiment was planted on August 20th, 1931, and the first counts were made on August 31st. Each plant in each plot was examined every week, and the scatter of the infection was plotted on a map each week. The infection figures were taken as percentages of the total plants in each plot. Should a plant show only one spot of Angular Leaf Spot it was considered an infected plant.

The appended diagram shows the mean percentage of infection for each of the four treatments for the first seven counts. It will be seen that the inoculated seed gave the highest percentage of infected plants for primary infection (primary infection is taken to be the first three counts), while the seed treated with sulphuric acid gave the lowest primary infection. The control seed and mercuric dust were intermediate between inoculated and sulphuric acid treated, and one must conclude from these figures that there was no real effect on primary infection obtained by dusting the seed with the mercuric dust. After the third count, the cotyledons were shed, and the percentage of plants attacked fell at the fourth count. By the fifth count secondary leaves were formed and true secondary infection had taken place. A point of great interest now arose. There was no difference between the percentage of plants showing secondary infection for the four seed treatments. Since the primary infection of the sulphuric acid treated seed was as high as 23%, one must conclude that seed treatment of this description has little or no effect on the secondary spread of the disease. The experiment is to be repeated this coming season, so we shall get further data on this point.

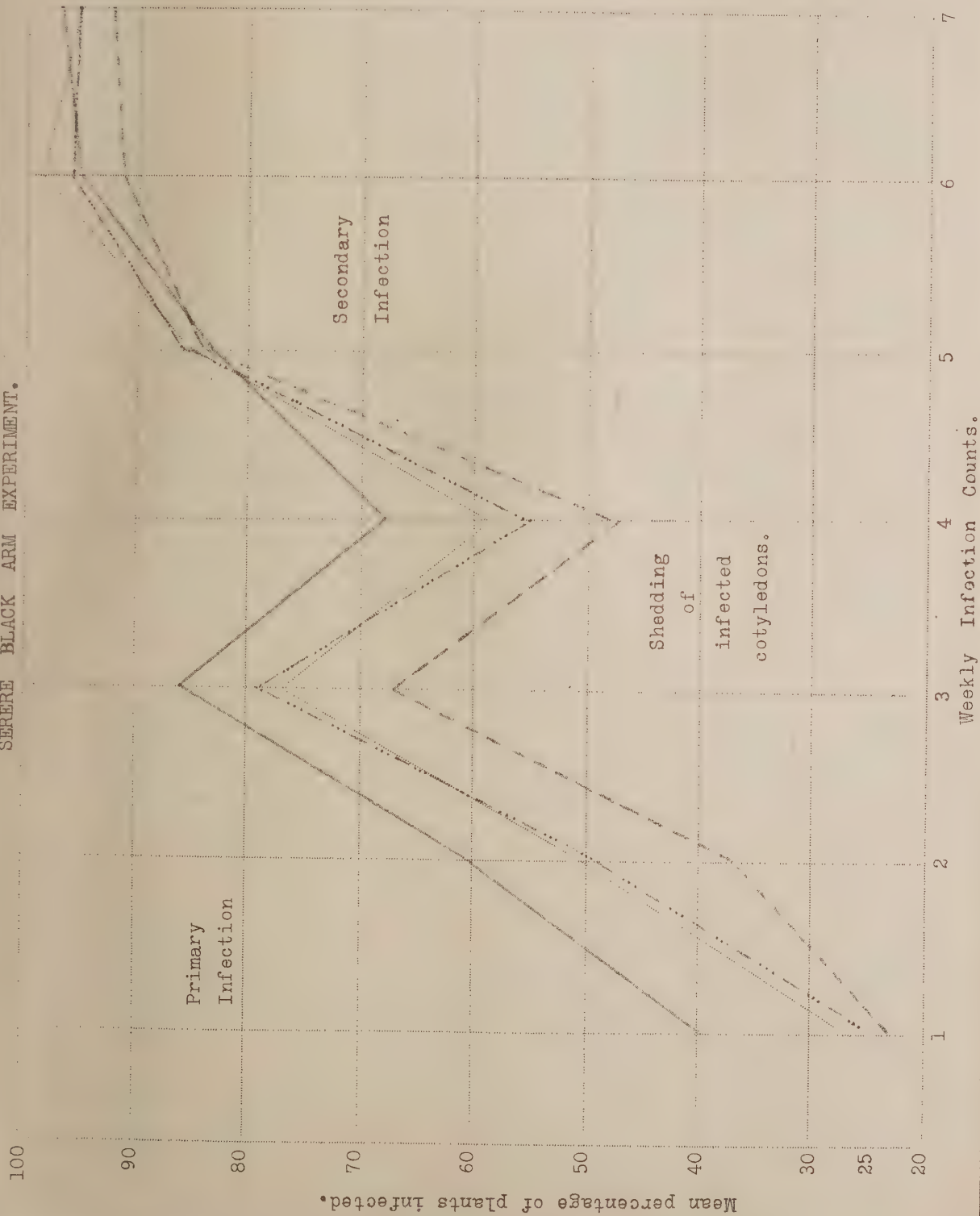
Another interesting point is that the mercuric dusted seed gave the highest germination, while the completely defuzzed sulphuric acid seed was slightly lower. It may be that the latter treatment is too severe and kills a certain percentage of seeds. The following are the percentage stand figures for the four treatments. Each plot was sown with ten seeds per hole and was not resown.

Treatment.				Percentage Stand Mean of four plots.	
Control	...	...	...	...	95.2
Inoculated seed	...	...	...	...	94.8
Mercuric dust	...	...	...	...	98.9
Sulphuric acid	...	...	...	...	97.7 (No statistical significance).

The following mean yields of seed cotton in lbs. were obtained, together with the following mean weights of diseased bolls:—

				Means of Four Plots.	
				Yield of Seed-cotton.	Weight of diseased bolls.
				Lbs.	Lbs.
Control	...	...	...	3.56	13.37
Inoculated seed	...	...	...	3.33	11.47
Mercuric dust	...	...	...	4.01	12.48
Sulphuric acid	...	...	...	2.75	12.79

SERERE BLACK ARM EXPERIMENT.



KEY.

- Sulphuric Acid.
- Mercuric Dust.
- Control.
- Inoculated with B. malvacearum.

Sulphuric acid appears to depress the yield, but the experiment was unable to show whether this was a real effect as there was no statistical significance. In considering the meteorological observations, it was found that there was marked correlation between increase of secondary infection and showers of rain of high average rate of fall. Showers which showed a rate of fall of less than 1/10th of a millimetre per minute had little effect on the increase of the disease.

The relative humidity also showed some correlation with the percentage incidence of the disease. This is only to be expected, since the humidity is very closely correlated with the rainfall. The air temperatures show nothing; the minimum air temperature varied very little throughout the experiment.

The highest percentage of plants showing Blackarm lesions occurred at the January 5th count, when 75.3% of the whole experiment showed lesions; while the highest incidence of Angular Leaf Spot was on November 2nd, when nearly 99% of the plants in the experiment showed this form of the disease.

The full results have been sent to the Mycologist at present on home leave, and it is hoped that they will be fully analysed by the Rothamsted workers.

INCREASE PLOTS.

Small Increase Plots.—Quarter-acre plots of each of the strains SP. 1, SP. 4 and S.G. 27 were planted. In addition there were two small plots of S.G. 23.8 once grown at Bukalasa, and S.G. 23.8 from Serere for the 1932–33 interchange of seed experiment.

Very satisfactory yields were obtained from all these plots, all averaged between 450 and 500 lbs. per acre. (SP. 1 is derived from U. 4.4.2; SP. 4 from S.G. 35, which originally came from Nyasaland No. 24; and S.G. 27 originated from Nyasaland No. 10).

Medium Increase.—Two acres were planted with some of the original S.G. 29 which was increased in a small plot last season. The yield of this was well over 600 lbs. per acre. The seed is to be planted on the main farm at Serere for the 30-acre stage next season.

Serere Main Farm.—The 30-acre stage in the multiplication scheme was planted with S.G. 29 which came from the two acres of the previous season. The yield was low, averaging only 300 lbs. per acre. It may be necessary to increase this stage to 40 acres to ensure enough seed for the Mulondo stage of the increase scheme.

THE MULONDO SEGREGATED AREA.

A total of 599 plots were planted with S.G. 29 by the natives living inside the Mulondo area; this gave a total acreage of approximately 400, the acreage in the previous season being about 402. As in previous years, Messrs. Foster Brothers bought and ginned the crop. The final buying figures were 169,259 lbs. of safi and 17,876 lbs. of fifi seed-cotton, or a total of 186,635 lbs. of cotton. This works out at an average yield per acre of 434 lbs. as compared with an average of 612 lbs. per acre in the previous season. The reduction in yield can be ascribed to the same causes as those mentioned under the heading "Meteorological Conditions."

The general grade of the Mulondo cotton was definitely lower than in previous years. Eight times as much fifi was bought as in the previous season, when the crop was over half-a-lakh larger. The staple was long, with rather high colour. Messrs. Foster Brothers have sent bales home, under special marks, which will be reported upon in due course.

THE SERERE VARIETY TRIAL.

This was situated on block B of the experiment farm. Six varieties (U. 4, N. 17, S.G. 29, S.G. 27.15.13, S.G. 27 and SP. 5), were arranged in ten randomised blocks. A spacing of 3 ft. by 1 ft. was used with sub-plots of 27 ft. by 27 ft., or approximately 1/60th-of-an-acre each. The experiment was sown on July 6th with six seeds per hole, and resulted in an average stand of just over 83%. The whole trial was resown on July 16th, and this resulted in an average stand of over 91%. The following figures show the number of blanks per plot per variety on July 31st, 1931:—

- (a) N. 17, 14.4.
- (b) SP. 5, 20.4; U. 4, 21.2; S.G. 29, 25.0.
- (c) S.G. 27.15.13, 31.1; S.G. 27, 31.6.

The value of "Z" for the analysis of variance of the blanks per plot is approximately 1.13; this is very significant.

The standard error of the comparison of two means is 3.04 blanks, and a significant difference between any two varietal means is 6.1 blanks. Consequently we see that N. 17 gave significantly fewer blanks than any other variety. There was no real difference between SP. 5, U. 4 and S.G. 29, but all three were significantly better than S.G. 27.15.13 and S.G. 27. There was no difference between the latter two varieties.

It should be noted that SP. 5 is a relation of S.G. 27.15.13, but is more nearly fixed. Both originated from S.G. 27 in the first instance.

There was little difference in the reactions of the different varieties to disease. Owing to the amount of time taken by the Blackarm experiment it was not possible to make counts of Blackarm infection in this experiment.

The yields were disappointing and gave no real significance—the value of "Z" being only 0.078. The chief cause for this was the unfortunate arrangement of the blocks.

The following figures summarise the results:—

VARIETAL MEANS.						
Strain.		Total Seed Cotton Lbs.		Soft grade Lbs.		Percentage of fifi.
U.4	...	...	5'96	...	3'90	34'5
S.G. 27.15.13	...	...	5'46	...	3'91	28'4
SP. 5.	...	...	5'43	...	3'78	30'4
S.G. 29	...	...	5'33	...	3'81	28'4
N. 17 Local	...	...	5'13	...	3'58	30'3
S.G. 27	...	...	5'08	...	3'60	29'2

No significance between any of the above figures.

A comparison of the picking curves (not included here) shows that U. 4 peak pick is a week later than the other varieties. This is surprising, since for the last two years this variety has always been earlier than others.

The percentage of fifi (stained cotton) is higher than usual. In the final pickings the varieties averaged over 50% of fifi.

[The results of the Serere interchange of seed experiment are to be found under the Bukalasa section].

OUTSIDE VARIETY TRIALS.

Similar 4 by 4 Latin squares of the same four varieties were laid down at eight centres in the Eastern Province. A separate draw was made for each trial. Owing to a mistake at planting, the Kabaramaido trial could not be included in the results.

The four varieties tried were N. 17, S.G. 27, S.G. 29 and U. 4. The writer is greatly indebted to the members of the Rothamsted Statistical Department for the computation of the results.

The following table shows the percentage yields of each of the four varieties at each centre:—

PERCENTAGE YIELDS.						
Centres.	S.G. 29.	S. G. 27.	N. 17.	U. 4.		
Ngetta	103'8	83'8	94'5	117'9	...	...
Aduku	99'4	101'8	83'2	115'6	...	...
Orungo	99'5	96'4	88'3	115'8	...	...
Labori	89'6	77'6	81'7	151'1	...	...
Nyero	96'0	98'7	92'8	112'5	...	...
Kamuge	101'1	96'7	85'7	116'5	...	...
Vukula	105'1	96'6	93'8	104'4	...	...
TOTALS	694'5	651'6	620'0	833'8	...	...

First of all the seven Latin squares were analysed separately, and it was found that only Labori gave significance by the "Z" test; this was due to the superiority of U. 4 over the other three strains. It was found that the estimates of the error variance at each centre were all estimates of the same variance, also, there was no marked trend of greater variance with greater yield, and *vice versa*. Consequently it was possible to make a combined analysis of variance, on the assumption that the variance is proportional to the square of the mean yield. From this combined analysis of variance the following conclusions were reached:—

1. U. 4 was superior to all others. (1% significance).
2. S.G. 29 was superior to N. 17. (5% significance).
3. No difference between N. 17 and S.G. 27.
4. The behaviour of the varieties is not significantly different at the different centres, with the exception that at the high yielding centre of Labori, U. 4 yields even better proportionately than is to be expected.

Rothamsted reported, "the results of the experiment are very satisfactory and are a good illustration of the value of replication not only in one place but at different centres."

By treating the seven Latin squares as one large trial, very significant results were obtained, whereas only one trial gave significance when treated as separate experiments.

THE QUARTER-ACRE COMPARISONS OF S.G. 29 AND N. 17.

Figures are now available for two seasons' quarter-acre comparisons of S.G. 29 and N. 17. The seasons are 1929—30 and 1931—32. The 1930—31 season was devoted to the comparison of S.G. 23.8 and N. 17, but this strain had to be abandoned owing to its susceptibility to Jassid, and S.G. 29 was repeated during the season under review.

The following table shows the mean yields of the two varieties for the two seasons. The comparisons were divided into district groups in this case.

MEAN YIELDS IN LBS. PER QUARTER-ACRE PLOT.										
		1929-30.				1931-32.				
District.		No. of comparisons.		S.G. 29.	N. 17.	No. of comparisons.		S.G. 29.	N. 17.	
Busoga	...	10	...	153'6	147'9	10	...	187'7	176'5	...
Budama	...	5	...	80'8	77'2	5	...	97'2	104'4	...
Bugwere	...	10	...	54'8	55'4	10	...	166'8	147'1	...
Bugishu	...	3	...	69'0	63'4	7	...	125'7	142'5	...
Teso	...	10	...	61'4	49'2	10	...	68'8	70'2	...
Lango	...	8	...	70'0	66'0	8	...	112'2	135'3	...
WEIGHTED MEANS	...	...	...	84'1	78'9	...	...	129'9	130'8	...

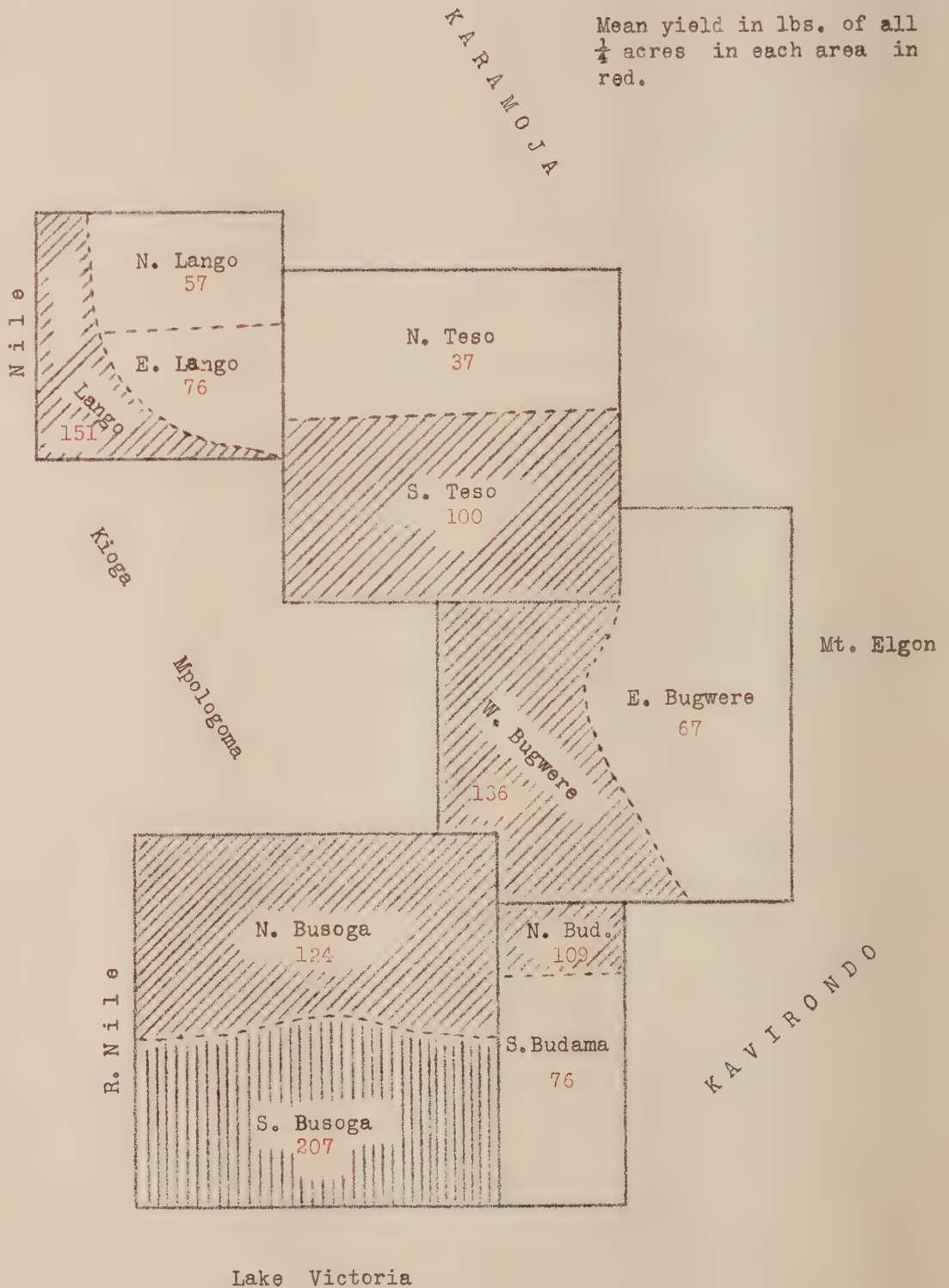
THE "YIELD-AREAS" OF THE EASTERN PROVINCE.

COMPILED FROM THE QUARTER ACRE COMPARISONS.

Shaded areas -
High and Medium yield.

Unshaded areas -
Low Yield.

Mean yield in lbs. of all
 $\frac{1}{4}$ acres in each area in
red.



It will be seen that every district, except Busoga, gave conflicting results for the two seasons. The 1929—30 season was the bad Blackarm year. A combined analysis for the two seasons of Busoga alone, shows no significance between the two varieties, although there is marked significance between the means of the two seasons. As would be expected from the above table, no other centre gave significance between the two varieties.

The weighted means for both seasons were slightly in favour of S.G. 29. It is interesting to compare the results of the outside variety trials with the 1931—32 quarter-acres. In the former case, S.G. 29 was definitely superior to N. 17. In the latter series of trials no significance was obtained, although the mean was in favour of S.G. 29. It should be noted that Busoga and Bugwere alone were responsible for this mean being in S.G. 29's favour in the 1931—32 season, whereas in the Blackarm year only Bugwere was in favour of N. 17. From this one might conclude that S.G. 29 stands up to Blackarm slightly better than N. 17.

Further examination of the results shows that the Eastern Province falls into definite "yield-areas." The appended plan shows the distribution of these areas. The areas representing each district on the plan are proportional to the total acreage planted during the 1931—32 season. It can be seen that the "yield-areas" fall into three groups:—

1. The high yielding area consisting of Southern and Central Busoga. This is elephant grass country and is influenced by the Lake Victoria rainfall.
2. The medium yielding area adjoining the Kioga—Mpologoma system of lakes and swamps, *i.e.*, West and South Lango, South Teso, Western Bugwere, North Budama and Northern Busoga.
3. The low yielding areas of North Lango, East Lango, North Teso, East Bugwere and Southern Budama. These parts of Lango, Teso and Bugwere border the dry Karamojan area, while South Budama borders the dry Kavirondo area of Kenya.

The following are the mean yields of all quarter-acre plots, irrespective of variety, in each of the "yield-areas" for the two seasons under review:—

						Lbs.
1. South Busoga	...	...	...	...	206'95	± 18'6
2. West and South Lango	...	...	...	...	150'58	± 22'3
West Bugwere	...	...	...	...	136'10	± 10'5
North Busoga	...	...	...	...	123'78	± 9'8
North Budama	...	...	...	...	109'00	± 11'8
South Teso	...	...	...	...	100'00	± 17'2
3. East Lango	...	...	...	...	75'92	± 11'5
South Budama	...	...	...	...	75'90	± 7'6
East Bugwere	...	...	...	...	66'73	± 5'2
North Lango	...	...	...	...	56'83	± 7'2
North Teso	...	...	...	...	36'70	± 10'0

Using the standard errors of these means, the following significances are obtained (*see* appended diagram):—

- (a) South Busoga significant over all other areas.
- (b) West and South Lango } significant over { East Lango.
West Bugwere }
North Busoga }
- (c) North Budama significant over { East Bugwere.
North Lango.
North Teso.
- (d) South Teso }
East Lango } significant over North Teso.
South Budama }
East Bugwere }
- (e) No significance between North Lango and North Teso.

When one considers the high yielding potentialities of the Bugondo—Kadunguru corner of South Teso (no quarter-acres were included in this area), it is obvious that South Teso should really be grouped with medium yield areas. Dividing the quarter-acre results into two groups on the above basis, *i.e.*, the high and medium yielding areas in one group and the low yielding areas in the other, and weighting the percentage difference of S.G. 29 from N. 17 by weights which are approximately proportional to the total acreage planted in each "yield-area," we find that the low yielding areas show a weighted mean of 6·8% in favour of S.G. 29, while the high yielding areas show a similar mean of only 1·2% in favour of N. 17.

These results are summarised in the appended table. The weights were obtained as follows:—

Districts	..	..	Busoga.	Bugwere.	Teso.	Lango.	Budama.
1931, acreage in 1,000's	...	...	138	...	116	...	37
Ratios	...	...	3'7	...	3'1	...	1'0
Weights	...	...	37	...	31	...	10

The "yield-areas" inside each district were given the following "weights":—

<i>"Yield areas."</i>					<i>"Weights."</i>	
North Lango	...	...	...	...	5'6	16'8
East Lango	...	...	...	...	5'6	
South-West Lango	...	...	...	...	5'6	
North Teso	...	...	...	...	10'0	30'0
South Teso	...	...	...	...	20'0	
East Bugwere	...	...	...	...	15'5	31'0
West Bugwere	...	...	...	...	15'5	
North Budama	...	...	...	...	3'3	10'0
South Budama	...	...	...	...	6'7	
North Busoga	...	...	...	...	18'5	37'0
South Busoga	...	...	...	...	18'5	

TABLE.

S.G. 29 YIELDS AS A PERCENTAGE OF N. 17. MEANS OF TWO SEASONS' COMPARISONS.
SUB-DIVISION INTO YIELD-AREAS.

<i>Group.</i>	<i>"Yield-areas."</i>	<i>N. 17.</i>	<i>S. G. 29.</i>	<i>Deviation of mean Percentage yield of S. G. 29 from N. 17.</i>	<i>"Weights" according to acreage of "yield-area."</i>
LOW YIELD	North Lango	100	107	+ 7%	5'6
	East Lango	100	92	- 8%	5'6
	North Teso	100	97	- 3%	10'0
	East Bugwere	100	118	+ 18%	15'5
	South Budama	100	108	+ 8%	6'7
	WEIGHTED MEAN	..	..	+ 6'8%	43'4
MEDIUM HIGH YIELD	West and South Lango...	100	89	- 11%	5'6
	South Teso	100	102	+ 2%	20'0
	West Bugwere	100	99	- 1%	15'5
	North Budama	100	95	- 5%	3'3
	North Busoga	100	100	—	18'5
	South Busoga	100	108	+ 8%	18'5
	WEIGHTED MEAN	...	...	+ 1'2%	81'4

Although no statistical significance can be attributed to the above results, they are interesting, as they indicate that S.G. 29 might be relatively more successful in the low yielding areas than in the high yielding. Also from the above results, we might suspect that the areas called here East Lango, West and South Lango, North Teso, North Budama, and possibly West Bugwere, are unsuited for S.G. 29.

However, when we take into consideration the mean percentage yield in favour of S.G. 29 and the results of the Outside Variety Trials in the 1931-32 season, we can say that nothing will be lost, as far as yield only is concerned, by introducing S.G. 29 throughout the Eastern Province, although there are areas where it appears to be unsuited.

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ANNUAL REPORT OF THE GOVERNMENT ENTOMOLOGIST.

STAFF.

The Medical Entomologist, his Laboratory Assistant, Laboratory Apprentice, and subordinate staff, were seconded to the Agricultural Department on May 4th.

The Government Entomologist went on leave on June 4th, his departure having been postponed for a month owing to the menacing locust situation. He was absent for the remainder of the year during which period the Medical Entomologist was in charge of the section.

The Laboratory Assistant returned from leave on June 9th. The Medical Entomologist was off duty from September 24th until October 1st owing to illness. The Assistant Entomologist and Laboratory Apprentice took local leave respectively for the periods 10th—23rd August and 6th—20th October.

GENERAL.

The tentative amalgamation of entomological staff proved successful. It enabled officers to carry out duties of both agricultural and medical interest at headquarters and during tours in the districts, thus economising while providing for continuity of investigations.

The outstanding features of the year were the extensive invasion and breeding of the hairy-chested locust (*Locusta migratorioides*) and the discovery of the pink bollworm of cotton (*Platyedra gossypiella*) in the Gulu district of the Northern Province. The locust menace was the main preoccupation of the section during the first half of the year; the advice of the Director of the Imperial Institute of Entomology was sought, and, as a result, Mr. H. B. Johnston, Chief Locust Investigator, visited the Protectorate during November. The presence of *P. gossypiella* was discovered during December by the Agricultural Officer, Northern Province, in the Madi area on both sides of the Nile; the Assistant Entomologist immediately proceeded to determine the limits of spread from the Sudan to the south and east.

Of the indigenous pests, the Capsid bug *Lygus vosseleri* was the cause of serious damage to cotton, while the berry-borer *Stephanoderes hampei* became unusually prevalent in coffee berries in Bwamba and Bugishu.

LOCUSTS.

The swarms of *Locusta migratorioides* which had been spreading from West Africa were first reported in Uganda during January. It has been stated that a swarm left the Belgian Congo around July, 1930, and flew toward Lake Albert, but no report was received of its arrival in Uganda; a single specimen of the phase *solitaria* was, however, collected in the West Nile district during February and this may have been a relic of earlier immigrants.

During January, February and March the swarms entered by way of the Nile valley from the north-western Belgian Congo and southern Sudan, and many crossed Uganda into Kenya and Tanganyika Territory. Egg-laying began about March, coinciding with the advent of the rains and it was consequently possible to give ample warning to Administrative Officers of the danger to native grain crops and to arrange for increased plantings of sweet-potatoes, cassava, sim-sim and ground-nuts. Egg-laying continued into April. Near Kampala, eggs hatched some twenty days after being laid and the hopper stages extended over a period of ten weeks.

The general direction of the migration of the winged swarms bred in Uganda was northerly into the Sudan but a small proportion travelled south-west into Belgian Congo. Other swarms entered the Protectorate mainly from the south-east from Kenya and Tanganyika. The northward movement ceased in September, swarms then tending to circle; a few returned from the Sudan, others moved south-east into Kenya though occasional swarms still came in from the south-east. This generation of fliers produced eggs in central Sudan as early as July, but in Uganda eggs were not laid until October. At the end of the year eggs were still being laid in the more humid areas near Elgon and in the south and west of the Protectorate; some of the swarms apparently scattered and either died naturally or were at least partly destroyed by birds or parasites. The swarms which matured and laid eggs during the autumn were far less numerous than those which had laid earlier in the year, and the hopper infestation was proportionally small. The earliest hoppers of the second generation were reported on October 26th at Attiak in Gulu; by the end of the year practically all hoppers had been destroyed in the drier areas of the Northern and Eastern Provinces. Very few mature adults of the second Uganda generation had been reported up to the end of the year.

The flying swarms which developed from the first generation of hoppers in uninhabited areas or in neighbouring territories, did much damage to native grain crops. The non-graminaceous food crops planted during the early rains proved, in most areas, sufficient to counteract the losses of grain.

The favourite wild foods of *Locusta* in Uganda are grasses, particularly "lusenke" and elephant grass. The following is a list of Monocotyledonous plants, chiefly of the grass family, observed to be attacked by this locust:—*Pennisetum purpureum* (elephant grass); *Imperator arundinaceae* ("lusenke"); *Eleusine coracana* (millet, "bulo"); *Andropogon sorghum* ("muwemba," millet); *Zea mays* (maize); *Saccharum officinarum* (sugar cane, especially Uba type); *Phragmites vulgaris* (reed); *Cymbopogon afronadum*; *C. citratus*; *Cynodon dactylon*; *C. plectrostachyus*; *C. transvaalensis*; *Leersia hexandra*; *Panicum maximum*; *Paspalum notatum*; *Arundinaria* sp. (bamboo, at 8,000 ft. on Ruwenzori); *Mariscus* sp. (sedge); *Cyperus* sp. (papyrus); *Musa* sp. (bananas); *Phoenix reclinata* (palm). In the Madi area, near the River Nile, papyrus was reputed the favourite food of young flying locusts, but in Buganda, probably owing to the abundance of more attractive food, papyrus was rarely eaten. Locust hoppers rarely attacked full-grown maize plants, but mature plants of both maize and sorghum were often stripped by flying locusts.

Other food included leaves of pineapple and of ground-nut (bunch-type only). Various other plants such as potato (*Solanum*), soy bean and pigeon-pea, were nibbled by hoppers but apparently as a source of moisture rather than as food.

ANTI-LOCUST MEASURES.

The first generation of hoppers was greatly reduced by ring-beating, burning and trenching, organised by officers of the Administration and of the Agricultural Department in the more densely populated areas. Action against hoppers continued throughout April and May, a particularly vigorous offensive being maintained in the Northern and Eastern Provinces, where grain crops are the staple food and where the infestation was most severe. In parts of these provinces, uncontrollable numbers of hoppers migrated from uninhabited areas (including those closed owing to sleeping-sickness) into cultivation, and there was a further immigration of large flying swarms, thus nullifying in some areas the great efforts to save the grain crops.

The second hopper infestation which developed during November was comparatively small and was easily reduced in the inhabited areas by the above methods.

Experiments with bran-bait, in a moist state and prepared according to the Sudan formula, were carried out near Kampala during the first hopper infestation, and the results were most discouraging; this was probably due to the humid conditions and abundance of fresh green food. Towards the end of the year, during a dry period and in short grass country, the bait was taken by hoppers and a satisfactory kill was recorded. At Kampala during May hoppers were quickly killed by sprinkling them or their food with sodium arsenite dust, but this method was too expensive and dangerous to be applied on a large scale.

GENERAL.

As is usually the case, birds of various species fed readily on both hoppers and adults. Several species of flies attacked locusts in egg, hopper or adult stage while a threadworm (*Mermis* sp.) parasitised hoppers and adults. None of these agencies, however, appears to have caused any marked general reduction in locust numbers.

Notes on the biology of *Locusta migratorioides*, together with series of coloured drawings made by the native artist were passed to Mr. Johnston for use by the Imperial Institute of Entomology.

COTTON.

PINK BOLLWORM (*Platyedra gossypiella*, Saund.).

This pest appears to have spread into Uganda from the Sudan where it was found as far south as Yei in 1929. Specimens of larvae submitted for identification in March, 1931, from Uele in north-eastern Belgian Congo, proved to be pink bollworm.

The known distribution of pink bollworm in Uganda is, east and west Madi and along the Attiak—Gulu road to Gulu township. If further investigation fails to reveal the presence of the pest in areas adjoining Gulu district, there are good prospects of restricting the infestation.

The caterpillars have been found in cotton bolls, often associated with those of *Argyroplote leucotreta* and care is needed to avoid confusion of the two species. Young larvae are difficult to separate in the field. The distinguishing characters of full-grown larvae are, the pink coloration is discontinuous in *Platyedra* while *Argyroplote* is uniformly red or dull reddish grey. Microscopically these larvae are separable by the following characters: *Platyedra*—prolegs with few crochets (hooks) arranged in the form of a horseshoe, setae with minute chitinated areas at the bases. *Argyroplote*—prolegs with at least twice as many crochets and arranged in a complete ring, setae with much larger chitinated areas at bases.

The habits of the two caterpillars in the boll appear very similar. The pupae may readily be distinguished:—*Platyedra* is pointed and has a hook (cremaster) at the tip; *Argyroplote* is blunt-tipped, without hook, and has a circle of tiny denticles on each segment.

It is not yet known whether *Platyedra* has a resting larval stage in Uganda, but no double seeds or seeds containing resting larvae were found. No wild food-plant was discovered; *Hibiscus esculentus* (okra) may be an alternative host. The above aspects are of great importance and they will require careful investigation. When considering wild food-plants the close similarity of the larvae of *P. gossypiella* and *P. erebodoxa* must be borne in mind: the latter feeds in fruits of several *Hibiscus* species.

The amount of damage due to pink bollworm in Gulu was difficult to estimate; it may perhaps have been equal to that caused by *Argyroplote*. The restricted field observations did not, unfortunately, give any facts to enable damage by these two pests to be differentiated.

CAPSID BUG (*Lygus vosseleri*).

Extensive leaf-damage, characteristic of this Capsid bug, and much boll-shedding, occurred throughout the Protectorate. In certain instances cotton shoots failed to develop fully and this, in many cases, could not be correlated with "Blackarm" disease. There seems little doubt that *Lygus* caused a considerable loss of crop, though it is probable that climatic factors favoured the prevalence of the pest and aggravated the damage caused by the bug to both bolls and vegetative parts. Examination of cotton plants, made in many parts of the Eastern Province, shewed that while the damage varied somewhat in extent, it was not possible to obtain positive correlation with high or low rainfall, light or heavy soil, or with local wet or dry micro-climates; in certain cases the damage was masked by excessive growth of the plants resulting from humid conditions.

At Serere, damage to leaves of "mpindi" (*Vigna catjang*) resembling that caused by *L. vosseleri* to cotton was reported; a large number of Capsids collected from such plants proved to be identical with the species on cotton. A preliminary experiment shewed that *Lygus* from "mpindi" could cause damage to cotton, but the beans matured before controlled experiments could be started and a later planting of the beans was not attacked.

JASSID BUG (*Empoasca fascialis*).

It has been suggested that this bug is of great importance as a cotton pest in Uganda. The difficulty is to ascertain the true status of the insect. While reddening of the margins of cotton leaves may be brought about by Jassid attack, damage of any sort to a leaf may result in reddening if the environment is favourable to such colour development. There are other forms of leaf reddening due to factors influencing the growth of the plant, and many or all the leaves become partially or wholly red. Judging from field observations it is possible that in Teso the insect is more likely to be a cause of loss; it is suggested that dry conditions accentuate the amount of the Jassid damage and the loss of crop.

A preliminary experiment was laid down at the Kampala Plantation to find out whether reduplicated experiments would be of value to determine:—

(a) The relative resistance to Jassid attack of the strains Cambodia, U. 4, S.G. 23/8, the related S.P. 6 and Delereet.

(b) Whether a susceptible strain was really water-tolerant and the resistance solely dependent on the suitability of the plant to its environment, *e.g.*, in the presence of a good water supply, would Delereet (very susceptible at Serere) be more resistant than Cambodia, when grown in the same plot and presumably obtaining too much water.

(c) Whether a good water supply was generally accompanied by a small Jassid population and/or less Jassid damage.

It was found possible to treat statistically some of the figures obtained, and previous conclusions, that S.G. 23/8 is more susceptible than U. 4 and Cambodia, were confirmed. Early in the season there were significant differences in the Jassid population of plants growing on the hill side and those growing in the swamp, the bugs being less prevalent on the latter plots. Later in the season however, the population of the swamp plot at Kampala increased but as this occurred so late as February, the increase had scarcely any practical importance; by that time the plants on the hill-side were nearly dead and had few Jassids on them. The weather at Kampala had been unusually dry and the influence of the swamp would consequently be below normal. The experiment therefore indicated that a further investigation along the same lines would give useful results and that the greener appearance of the plants with good water supply was coincident with a smaller Jassid population. Further, there was little evidence that the relative resistance of the varieties was materially altered by environment, though at Kampala the Jassid population of Delereet cotton was rather lower than was expected early in the season, but numbers increased near the end of the season.

The following figures for the above experiment give the average numbers of Jassid bugs per ten leaves, calculated by the Assistant Cotton Botanist:—

SERERE.—January, 1932.

Variety.	HILL-SIDE.		SWAMP.	
	Bugs.	S. Error.	Bugs.	S. Error.
U. 4.....	4.16	0.56	1.76	0.24
S.P. 6.....	7.60	0.77	3.86	0.56
Cambodia.....	1.71	0.59	0.81	0.27

KAMPALA.—January, 1932.

U. 4.....	3.68	0.53	1.84	0.35
S.G. 23/8.....	6.58	0.76	2.58	0.40
Delereet.....	4.65	0.93	1.98	0.36
Cambodia.....	2.29	0.65	0.74	0.18

KAMPALA.—February, 1932.

U. 4.....	Plants drying out, dead in some instances; comparable figures therefore could not be obtained.	1.08	0.20
S.G. 23/8.....		4.16	0.64
Delereet.....		7.64	0.78
Cambodia.....		0.56	0.17

NOTE:—At Kampala the soil and plant-growth on the hill-side were very poor, while in the swamp the humidity was very high early in the season and the cotton leaves were covered with areolate mildew.

An investigation was carried out to ascertain whether hairy strains of cotton had a larger or smaller Jassid population than had the comparatively glabrous strains. Two strains of the latter type shewed considerably more Jassids per fifty leaves than the more hairy types, but the variety Cambodia, which shewed no evidence of Jassid damage, was not more hairy than S.P. 9 A (a selection of S.G. 23/8) which exhibited considerable leaf-reddening. The observations were made very late in the season and only small secondary leaves were available for examination. Counts of Jassid nymphs were therefore made on marked plants of the four strains U. 4, S.G. 23/8, Delerect and Cambodia; five plants were selected in each of the eight plots and the bugs on ten leaves of each plant were observed once a fortnight, and at the same time specimens of leaves were collected and preserved. None of the plants under observation shewed a high or constant Jassid population and it was decided therefore that investigation of hairiness of the preserved leaves would be useless.

Other pests of cotton which were unusually prevalent included a mite, and the unidentified Aleurodid bug, nymphs of which were parasitised by the Encyrtid, *Eretmocerus diversiciliatus*, Silv. Damage by stainers was particularly severe in Gulu and Chua. *Helopeltis* bugs were abnormally abundant, and in parts of Chua and Buruli their damage was so intense that plants produced little or no crop. The other usual pests occurred in average numbers. A Pentatomid bug, ? *Halidocorys* sp., was noted on cotton bolls in the Eastern Province. *Geocoris amabilis*, St., previously thought to be a cotton feeder, was proved to be predaceous on other insects.

The observations for the determination of seasonal prevalence of cotton pests and of the amount of damage caused by them, were continued until the end of the 1930-31 season. During 1931-32 the growth of the cotton plants at Kampala was so abnormal as to render them unsuitable for continuation of the investigation. Details of the earlier season's results are still being studied by the Cotton Botanist who has not yet been able to complete and to correlate all the results of these and of similar observations carried out by him. The data given below indicate the large amount of damage which may be caused to cotton by insects.

Season ending	Buds Shed.		Bolls shed.			Bolls Harvested.		
	Cause.		Cause.			Clean.	Dirty or decayed.	Cause of blemish.
	Unknown.	Bollworm.	Unknown.	Lygus.	Bollworm.			
1929	571	236	717	337	445	583	131	Half bollworm.
1930 (a)	987	194	519	154	76	258	172	Mainly stainer but
1930 (b)	3,546	223	290	64	79	97	132	some Blackarm.
1931	1,735	95	312	363	49	268	44	Mainly stainer.

The collections of shed bolls 1929 and 1930 (a) were from beneath marked plants, but those of 1930 (b) and 1931 were from trays of wire-netting placed between rows of plants and the numbers of buds collected were therefore much greater. The figures for the different years are not comparable. The importance of insect damage varies with the age of the bud or boll attacked. The figures in the last column above may be regarded as dead-loss; in the case of the losses recorded under "bolls shed" as due to insect damage, however, the dead-losses would be fractions of these figures because the chances of bolls being shed without the agency of insects are considerable. It is expected that more detailed information will be available when all the boll-shedding figures have been finally examined and compared with the results, both entomological and botanical, obtained at Serere and Bukalasa. The figures for seasonal prevalence cannot be dealt with in this report and they will receive further consideration elsewhere.

FOOD CROPS.

SIM-SIM.

At Kampala, surveys of insects and observations on their seasonal prevalence were made. The following species were found on sim-sim and were much more common on plants grown during June—August, than on those grown October—December:—*Carbula armigera*, Fab., *Acrosternum* sp., *Veterna patula*, Dist., *Nezara viridula*, Linn. and *Agonoscelis versicolor*, Fab., all Pentatomid bugs, attacking the seed capsules; three undetermined species of Capsid bugs feeding on the fruits; a green aphid feeding on the young shoots; caterpillars of *Antigastrina catalaunalis*, Dup. (Pyralidae) eating leaves and flowers and boring in fruits; *Asphondylia sesami*, Felt. (Cecidomyiidae) causing galls on young fruit. Parasites of nearly all these pests became common during the growth of the first crop. Apart from a single generation of *Antigastrina*, the later crop was practically free from pests thus indicating that serious damage by pests may possibly be avoided by planting the crop during the later rains. The indigenous *Sesamum angustifolium*, Engl., is a wild host of *Antigastrina* and *Asphondylia*.

Considerable damage to sim-sim was caused at Serere by the gall-midge *Asphondylia*. Near Lira, during July, counts were made of galls on plants with green capsules which appeared to be susceptible to attack, and of galls on plants with black capsules growing in the same plot. Five plants of the former shewed 151 galls and 176 normal capsules while on five plants with black capsules the figures were 116 galls and 485 normal fruits. Other plots in Lango shewed damage varying from ten to fifty per cent. of fruits present; the great increase of the area of sim-sim, planted owing to the locust invasion, may account for the serious damage by this gall-midge. The Chalcidoid parasites *Eurytoma* sp. and *Aprostocetus* sp. were reared from such galls. Toward the end of the year damage by gall-midges was comparatively small.

SWEET POTATO.

Extensive damage to leaves was done by caterpillars of *Herse convolvuli* (Sphingidae) in parts of Buganda and the Eastern Province. This insect was formerly a very minor pest in Uganda.

MAIZE.

Surveys of insects on this crop indicated that the first two only of the following pests were of major importance:—*Busseola fusca*, Hamps. (stem-borer), *Argyroploce leucotreta*, Meyr. (seed-eater), *Parnara borbonica*, Boisd. (leaf-eater), and *Marasmia trapezalis*, Gn. (leaf-eater). A study of the life-cycle of *Busseola* gave duration of periods as follows:—Egg, 10 days; caterpillar, 68 to 74 days; pupa, 14 to 16 days; pre-oviposition, 3 to 5 days; while the maximum total of eggs laid by an adult was 249 during a period of five days. The borer attacks sorghum, millet and sugar-cane. A search for wild food plants yielded a malformed moth which indicates that elephant grass (*Pennisetum*) is a wild host of *Busseola*.

Observations at Kampala regarding the seasonal prevalence of *Busseola* and *Argyroploce* shewed that, while both caterpillars were prevalent on the earlier crop, they were very scarce on the crop grown during October—December.

OTHER CROPS.

TOBACCO.

Cutworms were responsible for much damage to young plants. There is great risk of attack by these caterpillars when the seedlings are transplanted immediately after the removal of dense growth of weeds from the field.

COFFEE.

Leaf-eating caterpillars of *Metadrepana* sp. incert. were very prevalent in parts of Toro during July. In the case of this species eggs appear to be laid singly whereas those of the species occurring in Buganda (*M. marantica*, Tams, previously recorded as *M. glauca*, Hamps.) are laid in columns. The outbreak was controlled by hand-collection; the wasp *Eumenes tinctor*, Christ., is a predator of the caterpillar, which was stored in pure culture as food for the wasp larvae.

The lace-wing (Tingid) bug *Habrochila placida*, Horv. occurred in large numbers on one estate. The outbreak was restricted to two small areas of trees; the bugs shewed no tendency to spread from the one area, while from the other, the spread was very gradual. At the same time abortion of flower-buds was prevalent; Capsid bugs were very rare.

In Toro, the general abortion of flower-buds caused much anxiety. As in previous years the phenomenon coincided with dull and wet conditions which were not broken by any long period of dry sunny weather. Preliminary experiments to determine what (if any) insects were responsible, using a kerosene solution of pyrethrum, gave no definite results. Artificial shading of trees had no effect on prevalence of bud-abortion. The type of abortion under consideration is characterised by the following: very young buds with petals not developed and capped with a thick brown resinous layer, fail to develop any further and are aborted; of a similar nature is abortion of buds which reach the stage when petals are about to open but which are gummed with much resin and which are aborted unless bright sunny weather ensues. Abortion of flowers, similar to that proved in Kenya to be caused by *Lygus simonyi*, also occurred but on a small scale and negligible compared with the amount of bud-abortion. On some estates *L. simonyi* was present but in small numbers, while in the same or other localities *L. capicola*, Stal. or *Volumnus obscurus*, Popp. were responsible for similar damage to flowers. The problem will receive further attention during 1932.

Antestia continued prevalent on some estates. Spraying with poison-bait was abandoned owing partly to unsuitable weather conditions; in one instance such spraying resulted in a severe attack by mealy-bug, presumably by poisoning the insects which normally hold mealy-bug in check. On some estates hand-collection of bugs was carried on but often without the assistance of smoke which is an essential for the success of this method.

PLANT IMPORTS.

Packages totalling 189 were examined; one containing cotton seed from India was destroyed.

MEDICAL.

MOSQUITOES.

Surveys of Arua, Fort Portal, Tororo, Lira, Soroti and Serere were carried out during 1931. The Kampala survey was considered sufficiently comprehensive, and activities in this township were restricted to the collection and examination of samples of anopheline larvae to check results of control measures carried out by the Sanitation Division.

The results of the surveys are given below. More detailed suggestions for control have been submitted elsewhere.

SURVEY OF ARUA (DRY SEASON).

The period covered by this account terminated in March since which time much has been done towards putting into effect the recommendations made.

The *Anopheles* to be found in Arua are as follows:—*A. funestus*, *A. gambiae* (= *costalis*), *A. maculipalpis*, *A. rufipes*, *A. nili*, *A. theileri* (the typical form and probably also var. *hancocki*) *A. mauritanus*, *A. marshalli*, *A. multicinctus* and *A. pretoriensis*. Of these, *A. funestus* is the commonest species in houses; *A. gambiae* also occurs in houses but much less commonly and it appears to be rare in European houses. *A. maculipalpis* is very abundant in the larval stage and has been shown experimentally to be capable of carrying malaria, but it does not appear to enter houses in Arua. The remaining species are either non-domestic or too rare to have any effect on the malaria-situation.

Breeding-places (under dry season conditions) are confined to the valleys of the three "rivers" Osu, Assa (with its tributaries Adumuni and Mindrei) and Anau. For the purposes of the survey the first constitutes area A, the second area B and the third area C.

Area A.—The river Osu has been canalised for the first three-quarters of a mile of its length, and the work is still in progress; all bush has been cleaned from the banks. The ditch contains but a trickle of water and is not breeding mosquitoes at present. Below the canalised portion the stream consists of a series of moderately deep semi-stagnant pools from each of which a trickle of water leads to the next; bush clearing in this part of the area is not complete. This part of the area breeds (as did the upper part before canalisation) numerous *A. funestus*, *A. gambiae* and *A. maculipalpis*. The sides of the valley contain large wet areas of seepage which breed large numbers of *funestus* and smaller numbers of *gambiae*. Two native water holes breed *A. gambiae*.

Area B.—This area is probably the source of a large proportion of the *Anopheles* found in European houses. The river Adumuni and various small tributaries of seepage (all now converted into ditches) occupy a valley south-east of the European houses. At the head of the valley are two open wells, one supplying drinking water for the European community (and breeding no *Anopheles*) and the other used for the watering of a tobacco-nursery and breeding *A. gambiae*. There are large and very wet seepage-areas both in the trough of the valley and on the sides; these breed many *A. funestus* and *A. maculipalpis*. The first half-mile of the main ditch is satisfactory, as are many of the subsidiaries, but below this point the floor of the valley is very wet and the earth in consequence so soft that the ditching has not been successful and the channel of the stream is broad, shallow, semi-stagnant and forming ideal conditions for the breeding of large numbers of *funestus*, which takes full advantage of its opportunities; *A. gambiae* also occurs but much less commonly than *funestus*. The whole of this part of the canalisation is subject to the criticism that the ditch is much too broad, resulting in much pooling and stagnation. Numerous small seepages occur in the actual banks of the channel and breed small numbers of *A. maculipalpis*. The muddy bed of the channel is also pitted with innumerable cattle hoof-marks which add much to the facilities for breeding. Below the end of the canalisation is the natural stream, winding, grass-grown, and with numerous pools breeding *funestus*, *gambiae* and other species of *Anopheles*. An attempt to drain some of the many bad seepage-areas here has not been very successful. In two places the course of the stream has been straightened by digging channels to cut off particularly bad bends but the old channel has not been filled in.

The river Assa, which joins the Adumuni, is of the same character, as also is the stream below the junction; in each there are large numbers of semi-stagnant pools breeding mainly *A. maculipalpis* and *A. funestus*. The last five or six hundred yards before the junction of the combined streams with the Mindrei have been completely cleared of vegetation as an anti-tsetse measure and the course of the stream has been much improved (but not straightened) and the banks trimmed and sloped. In this cleared section the flow is good and no breeding takes place except at one or two points where rocks or logs in the water obstruct the flow.

The Mindrei occupies a valley east of the Boma and flows south-east to join the Assa. The top of the valley contains the station vegetable garden; various small ditches between the plots do not appear to be breeding any *Anopheles* at present but will require careful watching; several of them hold stagnant pools. Below the garden the stream runs in a ditch with numerous side-ditches tapping small seepages; for the most part the flow in this ditch is good, but in those places where the grade is less steep it is becoming overgrown and obstructed by grass. One or two small native water-holes do not appear to breed.

A small tributary (the Aniova) has not yet been canalised and contains a number of bad pools which breed *gambiae* but is for the most part dry; the volume of water is very small and there is little or no flow. Below the Aniova and the Ori ditching has been somewhat unsuccessful on account of the softness of the ground, the course has not been straightened and the bottom of the ditch is too wide. Below the junction of the Ori (which has been successfully converted into a ditch) is the natural stream, usually about a yard wide, winding and with large semi-stagnant pools which breed *gambiae*, *funestus* and other *Anopheles*; for a short distance large boulders occur in the bed of the stream and obstruct the flow, these would probably require blasting if control is attempted at this point. These conditions (with numerous seepages on the banks) continue to the junction with the Assa.

Area C.—The river Anau is by far the largest of the small streams running through the township, which it crosses in a south to north direction. At its entry into the township it is a stream three to four feet wide, with fairly steep banks and with a considerable volume of water; from this point to the junction with the Olomini the course is partially or completely obstructed in numerous places by grass growing in the water and there are ideal conditions for the breeding of *A. funestus* (the Olomini is the only tributary south of the bridge carrying the road to the Italian

Mission which holds any water at present, and even in this case there is only a little at the mouth). From the junction with the Olomini to the bridge the flow in the stream is much better but innumerable obstructions (rocks, logs, sand-banks and occasional earth dams made by natives apparently for the construction of swimming-pools) seriously affect the flow and cause semi-stagnant pools, and the course is very winding. In the more open stagnant places *gambiae* breeds, and in grass growing in the water at the side of the stream *funestus* is very abundant. A hundred yards upstream from the bridge the course is badly obstructed by rocks and just above the bridge the stream has either been straightened out or cut itself a new course and the old course contains much stagnant water which breeds both *gambiae* and *funestus* in quantity. Below the bridge the stream becomes rather broader (5 ft.—6 ft.) but the flow remains reasonably good and there is little breeding except in the shelter of sand-banks, rocks, tree-trunks, etc. A small tributary not marked on the township map breeds *gambiae* and *funestus* and could very readily be canalised; much would be done by cutting away the earth which obstructs its proper fall into the main stream. For a quarter-of-a-mile upstream from the sim-sim mill the stream is much wider (15 ft.), with a very poor flow and very shallow in places; the outer bank of each curve is satisfactory but the inner is a mass of mud and footprints. These conditions are largely due to the fact that a mass of rock at the sim-sim mill obstructs the entire course of the stream and thus banks up the water above it; very large numbers of *gambiae* breed in this section. At the sim-sim mill itself there is no proper channel for the water which has passed over the wheel. Below the mill the stream is about 6 ft. wide and has in most places a good flow, but considerable pooling occurs; in this part of the stream there is a narrow fringe of trees and bushes.

The only important seepage-patch in the area is one of about an acre just below the mill. An attempt is being made to dry it for agricultural purposes by means of small ditches; these are for the most part stagnant and dangerous.

HOUSING.—There is not in the township a house which is mosquito-proof or capable of being easily made so. Being dark, the houses are ideal lurking-places for mosquitoes and to these facts I attribute in large degree the prevalence of malaria in Arua.*

MEASURES OF CONTROL.

Areas A and B.—Areas A and B are so much alike in general features that they can be taken together.

In each of these areas much ditching for anti-malarial purposes has been carried out and the bushes and trees have been removed in the upper parts of each to remove facilities for *Glossina*. This work of ditching is an essential preliminary to any more permanent anti-mosquito measures in Arua and has effected a marked improvement in the situation; I am convinced that it will not stand up to wet-weather conditions.

The volume of water in each of the streams is very small and is fed by numerous isolated areas of seepage. The District Medical Officer informs me that he wishes to plant up these seepage-areas with eucalyptus in the hope of drying them up. I am of the opinion that this would have the desired effect and strongly advise that it be done.

This measure will probably result in course of time in the complete drying of many of the smaller ditches (under dry-weather conditions) and should greatly reduce the already small volume of water in the main stream.

The ditches which now hold the main stream should be deepened considerably and agricultural drain-pipes laid in the bottom and covered. Each ditch would then consist of a comparatively shallow U-shaped channel to take storm-water (this channel should be planted with short grass to minimise scour and regular inspection and repair of scour will be necessary in the wet season) and the drain to take the normal wet weather flow. I am of opinion that after planting of eucalyptus in the seepage-areas ordinary agricultural piping should suffice to take the normal wet season flow of each stream in its upper parts (say to a distance of one mile from the head of each valley). The deepening of the channel should help greatly in drying out the floors of the valleys. Below one mile from the head of the valleys it is doubtful if the capacity of the piping would be sufficient and I suggest the cleaning, straightening and where necessary narrowing of the present stream-beds, coupled with regular inspection and oiling if found necessary; these measures should extend as far as the township boundary.

Area C.—This area is at a considerable distance from the boma; I do not consider it to be greatly concerned in the incidence of malaria in Arua and any measures to deal with it would inevitably be expensive. I do not, therefore, recommend that steps be taken with regard to this area until the other work has been carried out.

HOUSING.—The provision of suitable housing for the official community of Arua is (from the anti-malaria point of view) a matter of urgency.

GENERAL.—The results of the presence of cattle in the area where anti-malaria work is being done are very evident both in the breaking-down of ditch-banks and the formation of innumerable hoof-prints. Keeping or grazing of cattle within the area of anti-malarial measures should be prohibited.

I understand from the District Commissioner that the natives are to be removed from those parts of the township in the closest proximity with Europeans; this should be of value by reducing the degree of infectivity in the *Anopheles*.

* Since this report was written the housing conditions have been radically improved.

The local method of sweet-potato growing is even more dangerous than that in use in Buganda—the potatoes are planted on the tops of high mounds with hollows between; these hollows often hold water and the growing of this crop within the township should be prohibited.

Damming of the course of any of the streams by natives should be very severely dealt with.

PROPOSED REMOVAL OF TOWNSHIP.—A proposal to abandon the site of the township has been made; the cost of making healthy the present station would probably be far less than that of removal and the similar measures of draining, etc., which would be necessary in any suitable new site.

A further proposal to move the site about 600 yards to the north-east has, I am informed, much to recommend it from the point of view of health-conditions, the effects of this move on the malaria situation would be negligible. The proposed new site is more open and thus less suited for harbourage of mosquitoes; the removal would bring into the picture a further small stream, the Iwafu. This stream is smaller than those in areas A and B but similar in character; it could be dealt with at small cost by means similar to those recommended for the above areas. The move would also render less important any attempt to deal with the river Anau.

SUMMARY.—Malaria in Arua is mainly due to intensive breeding of *Anopheles* in the beds of three small streams and the seepages feeding them and to the entire absence of mosquito-proof houses. If the seepages are planted with eucalyptus trees, the streams turned into drains and mosquito-proof houses provided Arua will, I believe, be made almost entirely free from malaria.

SURVEY OF FORT PORTAL.

The mosquito survey of Fort Portal commenced in September, 1931, was carried on over a period of five months and included the wet season. September and January were dry, but during the other months rain was almost a daily occurrence.

Species of Anopheles.—The following species of *Anopheles* have been taken in and around the township: *marshalli*, *funestus*, *gambiae* (*costalis*), *transvaalensis*, *mauritanus*, *christyi*.

Anopheles marshalli and *A. funestus* have been proved by dissection to be carriers of plasmodia of malaria in Fort Portal and its environs. In the township itself the former is by far the more important species and represented 49% of the total adult *Anopheles* taken in human dwellings. It is common in European houses, and among the *Anopheline* larvae collected was the predominant species.

Anopheles funestus was only taken on two occasions as larvae, and never occurred in European houses. Excepting for native huts in one locality on the outskirts of the township adults of this species were rarely found.

A. gambiae (*costalis*), the important carrier in other parts of the country, was not found to be concerned in the transmission of malaria during the period covered by this survey. Its larva was not found in Fort Portal and only a few adults were obtained from houses; larvae were found in small numbers in another part of the district.

A. transvaalensis, though frequently taken engorged with blood in human dwellings, has not been incriminated in the role of transmitting malaria.

A. mauritanus and *A. christyi* do not occur in human habitations. They have been reared from larvae on rare occasions.

Infectivity of Anopheles.—During the survey 2,021 *Anopheles* were caught in houses. The result of examination of the alimentary tract and salivary glands is shown in the following table:—

Species.	Number examined.		Stomach infected (ocysts).		Salivary glands infected (sporozoites).		Percentage infection.
	Stomach.	Salivary glands.	No.	Percentage	No.	Percentage.	
<i>A. marshalli</i>	914	923	1	0·1	2	0·2	0·3
<i>A. funestus</i>	552	553	20	3·6	8	1·4	5·0
<i>A. transvaalensis</i>	430	435	—	—	—	—	—
<i>A. gambiae</i> (<i>costalis</i>)	11	11	—	—	—	—	—

No double infections (stomach and salivary glands of one and the same mosquito) were seen.

Distribution of Anopheles.—For the purpose of this survey the township was divided into five areas. In each area twelve native huts were chosen and a number of typical breeding places selected which by reason of their situation gave a fair representation of the mosquitoes to be found in that area. These observation huts and breeding places were searched for adults and larvae respectively at regular intervals.

Area A.—This area comprises the Bohoiga swamp which extends from the “Mountains of the Moon” Hotel to the Kampala road and the native huts in the near vicinity. It was in this locality that one infected specimen of *Anopheles marshalli* was found.

Native wells and stationary water in the swamp gave negative results, but in one place beside a path through the swamp where the central stream is exposed, larvae of *A. marshalli* were taken.

Area B.—A rough road branching off to the left near the entrance to the Hotel leads to Area B situated in the region of Nyabukara swamp. Native wells and water holes in the swamp are the principal breeding places of *Anopheles funestus* and of *A. marshalli* which occurs in huts in this area. Its long distance from the European residential quarters makes it an area of

secondary importance, though perhaps on account of its close proximity to the hotel it should receive some attention.

Area C.—The Kanyankoko and Nyakimya swamps and nearby huts made up this area. An important breeding place of *Anopheles marshalli* was near the culvert where the Congo road crosses the Nyakimya swamp. Observation breeding places in the swamp itself proved negative for Anopheline larvae of species known to transmit malaria.

Area D.—Area D comprised the River Mpanga and its subsidiary streams and ditches. In several places along the main stream, when the river was not in flood, *Anopheles marshalli* was found breeding in aquatic grasses bordering its banks, and in decaying vegetation lying in the water. A typical place of the latter type was near the Mpanga bridge. The small stream deriving its water from a spring in the hillside on the golf course was a constant source of *A. marshalli*.

Area E.—This area takes in the Karamaga swamp, the native hospital, a hill known as Buhinga, and the vicinity of the C.M.S. Mission. An overgrown swimming pool in the Karamaga swamp was a breeding place of *A. funestus*. The swamp below the native hospital where it forms a stream and runs beneath the road produced many larvae of *A. marshalli*.

Residential Area.—The houses of Government officials are situated in the vicinity of the old fort. No *Anopheles* breeding places were found within this area, but adult mosquitoes of the malaria-carrying species, *A. marshalli* (as well as *A. transvaalensis*) were common in houses at certain seasons. Their source is undoubtedly the small stream on the golf course and the Nyakimya swamp in the region of the Congo road.

Summary.—There appears at the present time to be no necessity for undertaking any major anti-malaria operations in Fort Portal.

The extensive swamps, which have a flora entirely different from those at lower altitudes, are not dangerous sources of *Anopheles* if undisturbed: When they are opened up by the removals of reeds, or the construction of a road through them they breed malaria-carrying *Anopheles*.

The observations carried out on breeding places made it very clear that *A. marshalli* does not normally breed in still water. In every case where larvae of this species were found there was a certain amount of flow in the water. Its ideal breeding place was at the side of a sluggish stream among aquatic grasses. Any anti-malarial measures should therefore avoid as far as possible the construction of channels causing slowly flowing water.

It is important to bear in mind that this survey was carried out during the wet season and that *Anopheles gambiae (costalis)*, a species which prefers warmth and sunshine, may show a considerable rise in density during the dry season.

SURVEYS OF LIRA, SOROTI AND TORORO.

These surveys commenced on May 22nd and the present reports are based on work up to July 28th, 1931.

The first question is that of housing; it was noted particularly that mosquitoes occurred in numbers in latrines which were not included in the general mosquito-proofing of the house. The pantry was also a favourite haunt of *Anopheles gambiae* and *A. funestus*. The activity of *A. gambiae* in the mornings was particularly noticeable up till even 8-30 a.m. on dull days, when they could be seen flying near (as well as resting on) the outside of the wire of verandahs. The observation of Garnham (Journal of Tropical Medicine and Hygiene XXXII p. 207) that *Anopheles* enter houses in the morning was confirmed in so far as a latrine was concerned. None were found during evening examinations and a considerable though variable number in the mornings.

The following counts were made at Lira:—

				<i>A. gambiae.</i>		
				Morning.		Evening.
July 3rd	...	...	...	10	...	Nil.
" 4th	...	...	...	14	...	"
" 5th	...	...	...	37	...	"
" 6th	...	...	...	9	...	"
" 7th	...	...	...	19	...	"
" 8th	...	...	...	5	...	"
" 9th	...	...	...	1 (door kept closed)	...	"
" 10th	...	...	...	4	...	"

This in no way indicates that Anopheline mosquitoes refrain from biting in the evenings. They are well known to be active both before and after sunset but apparently do not seek a place in which to rest until the mornings. In the Annual Report of the Assistant Entomologist for 1926 (Annual Report, Department of Agriculture, p. 29) he wrote: "Efficiency in screening houses against mosquitoes would be increased by making mosquito doors to open outwards and fitting them with a spring or other self-closing device." I still hold these views especially with regard to springs on doors and further consider the enclosing of latrines and the avoidance of light double doors a very important matter. The importance of keeping doors closed in the mornings should be emphasised. The importance of providing efficient proofing in Lira, Soroti and Tororo must of course depend on the policy adopted with regard to the control measures against mosquito larvae.

The climate and soils differ so markedly from those of Kampala that breeding places have required special study. The danger of the parts of the Eastern Province surveyed lies in their very dryness. Whereas a swamp may breed but few dangerous *Anopheles* or may become foul and full of red flocculent precipitates which are usually associated with the absence of Anophelines, the temporary marshes found in the Eastern Province furnish innumerable open

sunlit pools where *A. gambiae* breeds in large numbers. While these appear suitable for *A. funestus*, at least in places, this species was not as common as was anticipated (from the presence and nature of the vegetation) perhaps owing to the frequency with which the water was turbid from suspended particles, or possibly owing to a different seasonal distribution of this species. There is considerable difficulty in keeping channels clear owing to the sandy nature of the soil and the scour from open hillsides which occur in many of the marshes surveyed. These temporary marshes differ very markedly from a swamp such as Lugogo. The latter is a swamp on heavy soil in a locality with a fairly well distributed rainfall, whereas in many places in the Eastern Province there are marshes with a sandy soil liable to desiccation during the more extensive dry weather. In considering the question of afforestation I have been forced to ignore this all-important practical point, and, therefore, consider it desirable that the Conservator of Forests should be permitted immediately to experiment with different species of trees and with various species of eucalyptus, in a marsh with sandy soil (e.g., Soroti, area B, south of Soroti rock).

I also suggest experiments to test the comparative value of box-planting versus pot-planting in view of the amount of damage by termites which is reported as taking place in dry weather. Examination of roots of trees attacked (to note whether they have been damaged or twisted in planting) would be of considerable value, and the planting experiment cannot be considered as complete if it is only used to ascertain relative ease of establishment; termite damage to the established trees should also be carefully investigated. Funds for more frequent supervisory visits would accelerate the planting work in Soroti and Lira.

Cattle.—The presence of these roughly doubles the number of natural breeding places of *A. gambiae*.

Natives.—While it is obvious that natives and Asiatics must be the main reservoir of the malaria parasites it is assumed in the reports that permanent quarters such as police, railway quarters or bazaars cannot be abolished or removed; native squatters are assumed to be undesirable, as being a source of infection. Whether in fact a row of huts between European houses and a swamp acts as a bait (with the result that the mosquitoes go no further than to the swamp to lay eggs) it is impossible to say. For the purpose of the reports I have accepted the common (but unproved) assumption that the distance of flight of *A. gambiae* and *A. funestus* is about one mile, a few stragglers coming from two miles.

LIRA (SHORT DRY SEASON).

The survey commenced on June 23rd and this report covers the period up to July 12th.

The *Anopheles* to be found in Lira are as follows:—*A. gambiae* (*costalis*), *A. funestus*, *A. mauritanus*, *A. squamosus*, *A. pharoensis*, *A. rufipes* and *A. maculipalpis*; of these *A. gambiae* is the commonest species in houses. *A. funestus* occurs in smaller numbers in native huts. The other species are of no importance in considering control measures, as they will either be controlled by measures against *A. gambiae* and *A. funestus* or are not domestic in Lira.

BREEDING PLACES.

Breeding places are confined almost entirely to the marshes at the head of the tributaries of the Koli river and to wells, ditches and water-holes in or along these depressions. At the time of the survey some water was lying in these marshes but more water will no doubt be found after prolonged rain. When the survey was commenced no rain had fallen for three weeks but heavy rain fell during the last few days of the survey. This rain was followed by extensive surface run-off which requires drains of a large capacity.

For the purposes of the survey the township was divided into four areas. The first (Area A) extends from the Boroboro Mission road across the Soroti road to the Kitgum road and includes most of the main Koli valley. Area B consists of the head of this valley and some sand pits near the Indian dukas; this area extends from the mission road to the Kachung road. The most prolific breeding places are in area C, which consists of a marsh running down from a point on the Kachung road between the station and the bazaar and eventually joining the Koli river and further includes some water holes at the sides of this valley; this area extends to the Gulu road. Area D includes the part of the town lying between the Gulu and Kitgum roads and contains another tributary of the Koli and part of the main valley.

Area A.—The main marsh in this area contains a number of irregular holes among tussocks of grass and in these can be found numbers of larvae of *A. gambiae*. A considerable part of this area, south of the Soroti road, has been planted with eucalyptus and a central channel has been dug. Provided that this channel is kept clean it is probable that few mosquitoes will breed in this planted area. Further planting has been carried out below the warders' lines but there is a considerable area immediately below these lines which should be planted up to connect with the piece lower down which is already making satisfactory progress. Other breeding places in this area include a salt lick near the mission road and seepage wells. Two pits near the Soroti road and one near the Kitgum road are also breeding *Anopheles*, as are also some pits and ditches below the warders' lines. A few larvae of *Anopheles* occurred in the main channel and in the swimming bath, the overflow from which is breeding large numbers. *Anopheles funestus* was found in water holes; *A. pharoensis* occurred in the swampy area formed where the Kitgum road causeway dams the Koli river. A pit behind the rest camp is a dangerous place likely to breed *Anopheles*. The warders' well is stocked with fish (*Barbus* sp.) and contains no mosquito larvae.

Area B.—The breeding places of *Anopheles* in this marsh are similar to those in Area A and are as follows:—Two seepage water-holes at the head of the marsh; there is also a small salt lick which breeds *A. gambiae* and paths and hoof prints made by cattle. Along the Kachung

road are a few murrum pits of which few contained water and none larvae. There is also a seepage water-hole near the bazaar and some sand pits. These last contained little water at the time they were examined but should be carefully watched as a possible important breeding place of *A. gambiae*. There are also a few temporary puddles and motor wheel tracks in the bazaar.

Area C.—"Duka Swamp."—This area is both the most prolific breeding ground of mosquitoes and closest to the houses of Europeans and Asiatics. The upper part has been canalised but the ditches are wide and stagnant; they contain many hoof prints and are ideal nurseries of *A. gambiae*. The lower part of this swamp is also breeding this mosquito as are some wells and water holes which are indicated on the map.

Area D.—In this area are some brick pits at the head of a small marsh, two of which are near the township, below these there is a marsh which is similar to that in area A with also a few water holes; there are four further clay pits near the Gulu road.

All the marshes are liable to breed *A. gambiae* at practically any point after heavy rain and the points mentioned in the centres of these marshes must be regarded as sample points. All wells, pits and other holes are mentioned individually or, where a number of pits are practically contiguous, in small groups.

MOSQUITOES IN HOUSES.

An examination of both types of European house showed comparatively few *Anopheles* and the species found was almost exclusively *A. gambiae*. About five or six specimens were found per house on each occasion, the majority being found either on the back verandah or in the pantry or else in the latrine. Houses with the latrine enclosed showed many fewer mosquitoes in this situation.

SUMMARY OF CONTROL MEASURES.

Provided that afforestation is successful and cattle are kept out of the areas to be reclaimed the control of mosquitoes in Lira does not appear difficult. Draining and afforestation of the "duka swamp" and the marshy ground below the warders' lines should create a very great reduction in the number of Anopheline mosquitoes. The area which has been planted near the swimming pool is fairly close to the station and with the exception of a few wells and a pit near the rest house, these areas probably provide most of the Anophelines in the station. The removal of squatters is very desirable and cattle must be kept from the swampy areas.

The temporary nature of the marshes around Lira is such that, during rainy weather, they breed very large numbers of *A. gambiae* and this high concentration may necessitate the undertaking of all the measures of swamp control advocated before malaria can be abolished in the township.

Control measures carried out since the above was written have resulted in a considerable reduction in the Anopheline population of Lira.

SOROTI (SHORT DRY SEASON).

The survey was commenced on June 3rd and this report covers the work up to July 19th.

The *Anopheles* to be found in Soroti are as follows:—*A. gambiae*, *A. funestus*, *A. maculipalpis*, and *A. mauritanus*. Of these *A. gambiae* is the most abundant species in houses and the bazaar; *A. funestus* occurs in very small numbers in the police lines and the bazaar; *A. maculipalpis* is rare, and control measures for *A. gambiae* should equally eradicate this species.

For the purpose of the survey the town was divided into four areas A, B, C and D. Area A extends from the Amuria road to the Kumi road and includes two marshes at present being afforested. Area B extends from the Kumi road to the Kyere road (present Mbale road) and includes the portion of marsh south-east of the Arab's plot and the marsh running south-east from near Soroti Rock. Area C extends from the Amuria road to the Lale road and includes the marsh running from behind the prison and the portion of swamp from the Amuria road which joins the above in a piece of open water north of the township. Area D extends from the Lale road to the Kyere road and includes the marsh below the forestry plantation and another at some distance from the town on the old Kyere road.

BREEDING PLACES.

Area A.—Most of the two marshes in Area A has been planted with eucalyptus. Many temporary breeding places of *A. gambiae* exist in the depressions round the trees and in holes prepared for the planting of trees, but these will disappear when the trees become larger. The drains cut in connection with this planting also at present breed *A. gambiae* in considerable numbers. Other breeding places include a few water holes in this area. There are a number of irrigation ditches in the shamba of an Arab, and also old brick pits in the same shamba. In this shamba a brick channel leads from a spring to a water pipe from which water is carted and sold in the bazaar; this channel has a good flow of water and does not breed *Anopheles*. There are also breeding places of *A. gambiae* in sand pits near the Indian well, in the well itself, the ditch running from this and one other ditch nearby. There are large numbers of small places in the main marshes breeding *A. gambiae* which are not indicated individually, every small depression round the base of a newly planted tree being a potential temporary breeding place.

Area B.—In this area is a main drain which carries storm water, in the lower portion of this are seepages and a number of side drains, this main drain runs from the road which joins the Kyere road (near the rest house) to the bazaar. This main ditch is wide, shallow and full of cattle hoof prints; it breeds large numbers of *A. gambiae* and the same is true of many of

the side drains; cattle have broken down the banks and greatly increased the number of breeding places in this area. There are also a number of native wells in this area breeding *A. gambiae*. The channel merges into a marsh, consisting at first of short grass and pools and finally becoming swampy. A few *A. gambiae* were found in a pool in a rock and in a hole dug for obtaining mud for a hut.

In the same area is a marsh continuing from the south-east end of Area A, and in this are a number of pools in which *A. gambiae* were breeding; part of this is being afforested. This eventually joins the swampy area at the end of the other section of B. A number of large clay pits in this area were being oiled but would form ideal breeding places for *A. gambiae*.

Area C.—In Area C is a channel which runs down from behind the gaol and which has a number of subsidiary side drains. In all these ditches *A. gambiae* was found. The main channel is wide and sandy with crumbling banks and is a prolific source of *A. gambiae*; this channel runs into marshy ground where cattle graze and in which *A. gambiae* breeds freely. The Public Works Department clay pits opposite the gaol breed *A. gambiae* as also does a borrow pit on the station road. A few rock pools on the Lira road are a distant and unimportant source of *A. gambiae*.

Area D.—There are many drainage ditches at the head of this area and in the forestry plantation; nearly all these breed *A. gambiae*. Lower down this area becomes more marshy with stagnant pools. Cattle cause many further breeding places where they continually cross the marsh at a particular point. There is a large well, cemented round and very shallow, which is a prolific source of *A. gambiae*, as also are a few smaller water holes. In wet weather *A. gambiae* breeds in some murram pits along the Mbale road.

A marsh in this area south of the town on the old Kyere road is too distant to consider for the present.

SUMMARY OF CONTROL MEASURES.

The major work of importance is the abolition of wide shallow channels and numerous side drains breeding *A. gambiae*; this can be accomplished by a combination of canalisation, planting and subsoil drainage. In some places it is doubtful whether afforestation will be practicable, and further difficulties will arise in deciding the cheapest methods for revetting the banks of the main channels. The advice of the Public Works Department and the Conservator of Forests will be required in deciding where to plant trees and where to put in subsoil drainage, and on the subject of the best type of central channel. The removal of cattle is essential for this purpose as besides breaking the sides of the drains and making hoof prints in the channels, they create a number of breeding places in marshy ground where they have crossed streams or in their hoof prints where the ground is soft. There will then remain a few brick pits, sand pits, wells (with their overflow channels) and pools, the lower and more distant parts of marshes (which should be afforested) and one or two rock pools which should be filled in.

The better proofing of houses is very desirable in the present circumstances but it is hoped that the measures for the control of larvae indicated above will render this measure less urgent. The removal of squatters is certainly desirable but the importance of the bazaar and other large concentrations of natives and Asiatics as a source of infection will again depend on the efficiency of the anti-larval methods adopted.

TORORO.

The survey was commenced on May 22nd and work was suspended on July 28th. A considerable amount of rain fell at intervals, and conditions may be considered as intermediate, but in no way really dry.

The species of *Anopheles* found were *A. gambiae* (*costalis*), *A. funestus*, *A. maculipalpis*, *A. implexus*, two *A. mauritanus*, and a single *A. theileri*, var. *hancocki*.

The species of major importance is *A. gambiae*; *A. funestus* occurred in considerable numbers at the end of the survey. *A. maculipalpis* breeds in considerable numbers in places similar to *A. gambiae*, and will be controlled by measures against the former; only one adult of this species was, however, found in a dwelling house and the species cannot therefore be considered of importance.

The township was divided into three areas for the purpose of the survey. Area A includes the lower part of the river Turukuku from the Mbale road to Besson's ginnery and extends round the west of the township to the Mjanji road. Area B includes the top of the hill; it is bounded on the east by the road running from the Mbale—Malakisi cross road and passing in front of the Government houses to join the Mjanji road, which is the western boundary of this area. Area C includes the top of the river Aguria (Government shamba) and parts of the rivers Asiu and Turukuku; it also includes the ground to the east and north of Area B.

The problem of the control of malaria-carrying *Anopheles* in Tororo divides itself into two sections.

(A) *General sanitation including the filling up of pools lying on the surface of the iron-stone together with the constant inspection of this area and the Railway reserve.*

An Asiatic sanitary inspector would be required at least for a period of some months. If work can be made sufficiently permanent it may then be possible to dispense with his services in this direction. The permanence of the work depends largely on the policy to be followed with regard to natives and cattle. Both are most undesirable in the township and the latter should be prohibited within the two-mile township area. The former, if removed to $1\frac{1}{2}$ miles, would be unable to make the innumerable water holes and iron-stone pools which are estimated to supply at least 80% of the *A. gambiae* found in the town. If it is not possible to remove

natives (other than those in permanent railway and police quarters who cannot be removed) an alternative water-supply in Area C from the railway reservoir would greatly ease the situation.

(B) *Swamp Drainage.*

It will not be possible to afforest and drain the swamps satisfactorily if cattle are allowed their present freedom of movement. Afforestation is having very satisfactory results and an extension of the policy to the Asiu valley as surveyed by the officer i/c anti-malarial planting and to the Asiu stream should eventually effect the virtual abolition of the larger permanent breeding areas of *A. gambiae*.

BREEDING PLACES.

Iron-Stone Pools.—In Area A there is a large area of iron-stone extending north and south of the aerodrome. In Area B these pools are confined to the angle of the Mjanji road and the road from the Government houses.

In Area C there are two sections of this rock in front of the Government houses. There is another area in front of the railway houses, one behind the Uganda Company and one in front of this building above the cart-track on the south side of the Railway reserve. In a few cases there are other cart or motor tracks over this iron stone; no traffic should be allowed over the thin layer of soil which alone provides root-hold for the grasses which keep the area reasonably dry.

Other breeding places.—In Area A there are murrum pits along the road to the Budumba ferry, another pit, seepages, wells and swampy ground badly poached by cattle at the head of the Asiu river. *A. gambiae* also occurred in a small marsh and the ginnery reservoir and tank. Comparatively few *A. gambiae* were found in the recently-afforested part of the river Turukuku west of the Mbale road. *A. funestus* was found in thick bush near the Kampala railway line as also were *A. mauritanus* and *A. implexus*. In Area B, larvae of *A. gambiae* had previously been recorded by the District Medical Officer from a rock pool (now filled in); a borrow pit and murrum pits on the Mjanji road; three other rock pools were only found to be breeding *Aedes* at the time of the survey.

In Area C, *A. gambiae* occurred sparingly in the springs and ditches of the Government Plantation. *A. maculipalpis* was rather more abundant. *A. funestus*, though not found, would be likely to occur in the overgrown parts of this area. A cattle salt lick is breeding *A. gambiae* and a few *A. maculipalpis*; *A. funestus* was found at the edge of the Aguria river below the shamba. Small native pits were breeding *A. gambiae* and a seepage round the spring at the head of the river Arutye was also breeding. This species also occurred scattered throughout the marshy areas round the Asiu and in seepages and a salt lick where also occurred *A. funestus* and *A. maculipalpis* under a bank where the cattle had licked out a cavity. This marshy area was poached by cattle in many places and *A. gambiae* was breeding extensively throughout the area during the first weeks of the survey. At the end of the period of the survey the water level had fallen and decay with red flocculent iron precipitate had rendered much of this area unsuitable for *A. gambiae*. The sand pits near the crossing of the Malakisi road and the Kenya—Uganda Railway were also breeding large numbers of this species. In the Turukuku valley some *Anopheles* were found around the trees and in seepages but when the trees have grown up this area should be satisfactory. *A. gambiae* occurred also in a water hole (with *A. maculipalpis*) and in a well (with *A. funestus*).

COLLECTIONS IN HOUSES.

The dominant species found in houses was *A. gambiae*; *A. funestus* occurred in some numbers at the end of the period under review and a single *A. maculipalpis* was collected in a Government house. The number of *A. gambiae* per house varied from 38 in the rest house to one in a railway house. The District Medical Officer estimates an average catch of mosquitoes at about 15 per house per collection; his maximum collection is one of nearly a hundred in the District Commissioner's house behind which was a rock pool since filled up. These extremely high counts can (by comparison with such a place as Soroti) only be due to the iron-stone pools. The number of mosquitoes found on verandahs is no doubt partly due to double doors opening inwards.

SUMMARY OF RECOMMENDATIONS OF MAJOR IMPORTANCE.

(1) All pools in the iron-stone should be abolished by filling in and planting with grass. A few pot-holes may require a little concrete.

(2) Cattle should be kept out of the township as these (by destroying the thin surface layer of turf over the stones and on account of the fact that their owners enlarge the holes to make drinking places) are the chief cause of the above pools and contribute to the production of other breeding places of mosquitoes.

(3) The main swamps require afforestation.

(4) A few wells, pits, etc., require filling.

(5) A sanitary inspector is required in view of the ease with which pools are formed in the town and the presence of a considerable population in the railway reserve.

Note.—Since the above was written, the filling of the shallow pools by the local Medical and Administrative authorities and such other measures as they have been able to adopt with the funds available have given very promising results and it has since been difficult to find any *Anopheles* in the houses of Europeans.

SERERE.

During the dry weather in January numbers of mosquitoes were reported in the houses on the top of the hill and also in a tent. Collections by the boy from the Uganda Malaria

Survey Unit revealed the presence of *Anopheles funestus* and *Culex univittatus*; in both cases males and females were present.

Examination of tanks and temporary breeding places were negative, the latter all being dry, and I was informed that the rain in early January had not remained long enough in any pools for mosquitoes to breed.

Most of the swamps were dry and the only places where mosquitoes were found breeding were the swamp on the Bugondo side and in the large clay pits dug at the upper end of it. The species there included *Anopheles gambiae*, *Anopheles funestus*, *Culex univittatus*, *Culex annulioris*, and the predaceous *Lutzia tigripes*.

The well from which water was being carried up to the tanks attached to the houses contained no mosquitoes; a well recently in use contained *A. gambiae* and appeared suitable for *A. funestus*.

The absence of *A. gambiae* in the houses would indicate that it is unlikely that the mosquitoes were being carried up with the water, while the association of the *Culex* makes it tolerably certain that *A. funestus* was coming up from the swamp. Mosquitoes were reported after a change of wind during the day which was followed by rain, the wind coming from this swamp whereas formerly it had been blowing from the opposite quarter. There was a fair amount of cover between the station and the swamp, though much of the grass had been burnt. There is also a straight road to the swamp planted with mangoes along its sides.

The presence of *A. funestus* and the absence of *A. gambiae* indicate that the mosquitoes had not been driven up by smoke from fires in the swamp. And it is interesting to note the apparent difference in dispersal distance of these two common malaria carriers. A further unexpected observation was that *A. gambiae* was breeding in vast numbers in water covered with a flocculent red iron precipitate. Without chemical and botanical examination of the water this apparently unusual occurrence cannot be discussed.

Further observations were made in July and it was found that a large pool lying on a piece of iron-stone rock and used for watering cattle was breeding *A. gambiae*; this was the only important temporary breeding place found.

Additional breeding places found at this date included a few wells in the marsh which lies between the station and the Soroti road. The borrow pits along the main avenue were not holding water but it is possible that during prolonged rain, water might lie in these long enough to breed *A. gambiae*. It is further possible also that the marsh near the Soroti road may contain pools during prolonged rain and that *A. gambiae* may find suitable breeding places.

The large pool on the iron-stone is a very important breeding place of *A. gambiae* and is close to the houses; it requires filling up. The swamp on the Bugondo side should be drained sufficiently to allow the planting of eucalyptus, and the clay pits will require at least partial filling. The marsh near the Soroti road is not known to be a serious source of *Anopheles* but with the provision of new wells by the water-boring section of the Public Works Department the old ones can be filled in and if water is found to lie for long periods in this marsh some planting may be found desirable. No cattle should be allowed to graze in the marshy areas and they should only be watered at one or more selected points.

The proofing of houses is very inadequate and in view of the small size of the station good proofing and the clearing of the top of the hill of grass and bushes might be found to be an economical and satisfactory method of dealing with the mosquito problem.

House tanks have been used for the storing of water from wells in which *A. gambiae* breeds. If this practice is to be continued the traps on the tanks should be made to fit properly and to work freely.

The labour lines and school dormitory are situated on the apparent line of flight of *A. funestus* and they may be a source of malarial infection. Other probable sources are huts north-west of the main avenue and south of the road leading to the rest camp. Personal servants or their children are also another possible source of infection.

MOSQUITOES (GENERAL).

Small containers.—In view of statements often made that tanks, gutters, etc., are sources of Anophelines, a special survey of such places in Kampala was undertaken. The results were entirely negative so far as Anophelines are concerned and are given below:—

(a) Of 127 tanks containing water, 44—rather more than one-third—contained mosquito-larvae. None contained larvae of *Anopheles*. Practically every tank with larvae contained those of *Aedes argenteus* (= *Stegomyia fasciata*) and a few had those of *Culex horridus* and *C. fatigans*. All these species of mosquito are domestic.

(b) Few gutters retain water long enough to permit of breeding but occasionally a gutter is found which is sagging seriously; in such cases (particularly if there are trees shading the gutter) *A. argenteus* is usually present.

(c) The investigation was divided into an examination of European houses and those of Goans and Indians. The only differences found are, that the houses of Indians do not usually have tanks, that their gutters are somewhat more apt to be neglected and that they more commonly have barrels for water-supply and odd tins lying about their compounds. Goans are intermediate but most have tanks. It seems unnecessary to give separate figures.

(d) In barrels also, no *Anopheles* have been found, though many searches have been made. They very frequently contain larvae of *Aedes argenteus* and *Culex fatigans* and occasionally those of other species. Exactly the same remarks apply to old tins, piles of discarded motor-tyres, and bottles or pots.

(e) An investigation has also been made of the mosquito fauna of tree-holes. Hundreds of examinations have revealed no instance of *Anopheles* breeding in such places, but *Aedes argenteus* does so very commonly. The remainder of the mosquitoes found commonly in tree-holes are not domestic.

RECOMMENDATIONS.

(a) There is no case for the abolition of tanks and gutters on anti-malarial grounds, but there is ample reason for the removal of tanks as serious sources of domestic mosquitoes.

The extent to which gutters breed mosquitoes is insufficient to justify their removal, and I believe their removal to be undesirable because the puddles from the drips may form breeding-places suitable for *Anopheles*.

If tanks are removed it will be essential to provide satisfactory facilities for the drainage of water from the roofs.

Gutters should not be punctured but badly sagging stretches should be repaired and any branches overhanging gutters should be removed.

(b) The removal of tins, motor-tyres, bottles, etc., is too much a matter of general sanitation to require comment. It will not be possible to abolish water-barrels until the consumers are provided with some other water-supply.

(c) Tree-holes can readily be dealt with either by filling with earth or, preferably, by cutting a channel to allow the water to escape. This should be done.

Smaller scale investigations carried out at other stations have given results which are in full agreement with those obtained in Kampala.

Paris Green Larvicide.—Indications were found that the application of Paris green as a control for Anopheline larvae at Kampala was not yielding satisfactory results. An investigation of this subject was begun subsequent to the period covered by this report.

Forests.—Further investigations of the mosquito fauna of swampy forests near Kampala have confirmed the view previously expressed that under heavy forest shade none of the known malaria-carriers can find conditions suitable for breeding; the only Anophelines present were (as in last year's observations) *Anopheles obscurus* and *A. implexus*. *Anopheles funestus* occurred, however, in a comparatively open spot in thick bush (not forest) at Tororo.

Considerable afforestation with eucalyptus has been carried out in Kampala by the Township Authorities, but it is too recent to have produced any marked effect.

A further survey of Lugogo swamp has been made to ascertain the degree of control of breeding attained and is detailed below. On the whole, the results are not entirely satisfactory but it is hoped that the information gained through this piece of experimental planting will enable better results to be obtained in the future; it is possible that the trees in the less satisfactory parts of Lugogo will yet show better growth and if this should not occur, a comparatively small amount of drainage and replanting should make the situation satisfactory.

Lugogo Swamp.—This swamp was selected in 1929 by Colonel James as being the only swamp with moderately deep water, not already largely drained, which could be found within the township boundary.

The object of the experiment was to continue the work done at Kalume by the Forestry Department and to prove the statement made by the Forestry Officer at that time stationed in Kampala that deep papyrus swamp could be completely dried up by planting eucalyptus, with the assistance of a central channel and one or more subsidiary channels where strong springs existed in tributary valleys or bays.

Mosquito observations were to be kept to note what increase or decrease took place in numbers of the species known to carry malaria and what time is necessary for any temporary increase to be controlled by the growth of the trees.

There were two special factors operating in the swamp which may be correlated one with another: (a) a road crossed the swamp and, apart from the outlets of two culverts, formed a dam; (b) the swamp was dirty, full of red iron precipitate, and with the exception of one or two pools and a few ditches near the edges, was not breeding any important malaria-carrying species of *Anopheles*. This absence of Anophelines may have been largely due to the stagnation caused by the road crossing the swamp resulting in an accumulation of decaying vegetation and conditions generally unsuitable for Anophelines.

Regular observations on mosquitoes found were kept from September, 1929—May, 1931, and occasional visits were made subsequently. It is unfortunate that the absence of the entire staff of the Medical Entomologist from Kampala during the early part of 1930 rendered supervision impossible during the most important stage of clearing and planting.

The growth of the trees has been very variable. In some places it has been good and the swamp has been dried out; in other parts trees have grown but after reaching a height of 30 ft.—40 ft. have fallen over; in other places trees have hardly grown at all or have died. Some of the trees have received severe checks and may be unable to grow further. Nowhere has the growth of the trees been so good as when they are planted on land which is not swampy and where the soil has no especially unfavourable characteristic.

In general it may be said that about three-quarters of the swamp has dried up and that in some of these places the canopy is thick and perhaps sufficient to prevent the breeding of any important species of *Anopheles* should water again accumulate.

With the exception of a few pools those parts of the swamp which have not dried out have gone back to the stagnant conditions which existed previous to planting; the original planting was accompanied by the creation of numbers of small temporary pools in which *A. gambiae* and *A. funestus* bred during 1930-1931. Their absence from existing water is probably due to this being again unsuitable for them owing to stagnant conditions.

It is not therefore possible to draw very valuable conclusions as to the time which is likely to elapse between tree-planting and the control of Anophelines, but certain points of interest have been elucidated regarding the planting of eucalyptus and its value in draining swamps.

It was expected that eucalyptus would grow rapidly in almost any soil without any draining but it is clear that (1) temporary drainage is needed to establish the plants which will probably eventually be able to take up most of the water (2) Soil factors (perhaps the existence of pans) are important: trees planted at the edge of the swamp on clay have hardly reached a height of 6 ft., while others in apparently suitable soil have been checked, and may or may not be able to grow further (3) The rate of tree growth is very variable and in unfavourable conditions it may be a number of years before surface water is either eliminated or so heavily shaded that Anophelines cannot breed. In extreme cases eucalyptus planting is a failure.

It is therefore considered advisable to continue observations to determine whether the trees, at present showing unsatisfactory growth, will overcome the natural difficulties.

OTHER NOTES ON MOSQUITOES.

(a) Investigation of the question of flocculence (usually containing iron) in water as a deterrent to the breeding of *Anopheles* has been begun, but has not yet given conclusive results.

(b) Several species of *Anopheles* have been added during the year to those previously recorded from Uganda, including *A. ardensis*, *A. christyi*, *A. distinctus*, *A. multinctus* and *A. pretoriensis*. None appears to be common and none likely to be seriously concerned in the transmission of malaria. The description of larvae of *Anopheles theileri* from South Africa has rendered it almost certain that the form (var. *hancocki*) concerned in the spread of malaria in Kampala is not a form of *theileri*.

(c) Two batches of Culicine mosquitoes identified for the Kenya Medical Department are of some interest. The first comprised a very large number of a species of *Culex* which had been breeding in enormous numbers in Nakuru Lake and causing very serious discomfort to the inhabitants of the town; they proved to be *Culex mirificus*, a species previously thought to be very rare and therefore unimportant. The second batch was of a species believed to be implicated in the spread of a virus disease of sheep and consisted of species of the sub-genus *Coquilletidia* of *Mansonia* (late *Taeniorhynchus*) including *M. fuscopennatus*, *M. versicolor* and a third species which it was not possible to identify with certainty.

RATS AND FLEAS.

By arrangement with the Senior Health Officer, Kampala, rats caught by his staff were examined for fleas during the greater part of the year. Of the 779 rats captured 206 were *Rattus rattus*, the remainder consisting almost entirely of *Arvicanthis abyssinicus*, but including a sprinkling of other field-rats (mainly *Otomys* ? *angoniensis* and *Lophuromys* ? *ansorgei*) and a very small number of *Rattus* (*Mastomys*) *coucha*.

The distribution of fleas on these groups is of considerable interest:—Of the 206 *R. rattus*, about 35% bore fleas and the fleas were almost entirely the best-known tropical plague-flea, *Xenopsylla cheopis*; the actual numbers of fleas were 305 *X. cheopis*, 35 *X. brasiliensis*, 8 *Dinopsyllus lypusus*, two *Ctenocephalus felis strongylus*, and one *Ctenophthalmus cabirus*. On the other hand, the field rodents were comparatively free of fleas, which were only present on about 8%, and the proportions of the fleas were quite different: the predominant species was *D. lypusus*, of which 51 specimens were collected as against 11 *X. cheopis*, two *X. brasiliensis* and one *C. felis strongylus*. Of the few *Xenopsylla brasiliensis* taken, nearly half occurred on a small collection of rats from villages outside Kampala.

These figures would seem to indicate that contact between *Rattus rattus* and field-rats in Kampala is small—an inference which, if substantiated, would considerably simplify the problem of plague control.

TSETSE FLIES.

Work has been confined to examination of *Glossina* collections sent in for this purpose by Medical Officers and to keeping up-to-date the map showing the known distribution of these flies.

H. HARGREAVES,

Government Entomologist.

ANNUAL REPORT OF THE MYCOLOGIST.

I have been on duty throughout the year, with the exception of a short period on sick leave in February. Two visits were made to Toro in connection with the coffee trouble described below.

A tour of inspection of the main cotton areas of the Eastern Province was made in November to gather information on the damage caused by Blackarm disease as compared with that due to other factors. Other visits were made during the year to Masaka and Mityana to inspect cotton, and to Lugazi to inspect the P.O.J. cane varieties now being grown there on a large scale.

PLANT DISEASES DURING 1931.

COTTON DISEASES.

The 1931-32 season has been a season of prolonged wet weather in practically every part of the Protectorate. It was feared that these moist conditions would result in an epidemic outbreak of Blackarm disease, as many similar bacterial diseases are favoured by such climatic conditions. On the whole, however, the disease was not exceptionally severe, though the promise of a large cotton crop shown in the early part of the season has not been fulfilled.

The plants in most areas showed great vegetative development, but no corresponding boll production. Flower and boll shedding were abnormally severe; disease played a minor part in this shedding which was mostly the result of the climatic factors, combined with attack by insect pests. Shedding from Blackarm attack was unimportant, and on the whole this disease has not been a major factor in limiting the crop production during the past season.

Other observations on Blackarm disease, supplementary to the general account published in my last Annual Report, are given in Appendix I.

Sore Shin disease (*Rhizoctonia solani*) gave trouble in some plots where sowing had been followed by a dry period during the germination of the seed.

A rotting of the bolls due to *Diplodia theobromae* caused considerable damage in some parts of Buganda Province, where the weather has been exceptionally moist. This is the first time this disease has given trouble in Uganda in my experience. Many of the bolls infected with *Diplodia* show traces of infection by *B. malvacearum*, and in such cases it is probable that the fungus is secondary.

Towards the end of the season reports were received that the staining of the cotton in some areas was rather more severe than is usual. This staining was partly due to *Nematospora gossypii*, and partly to other fungi and bacteria having attacked the bolls under the damp conditions prevailing.

COFFEE DISEASES.

"Die-back" in Toro.—The area affected comprises several of the estates planted within the last three or four years. The early symptoms of the trouble are a burning of the edges of the younger leaves, followed by the gradual defoliation of the trees. Young growth formed is abnormal in appearance, the internodes being shortened, the young leaves more or less chlorotic and often curled or otherwise malformed, and being smaller than usual. The branches die back to the main stem in the middle of the trees, as is usual in most forms of "die-back" on single stem trees in Uganda, followed by the basal primaries, which in "die-back," due to such causes as over-cropping in other parts of Uganda, usually remain alive. Finally, a small tuft of abnormal foliage remains at the top of the main stem, and in some areas 50% or more of the trees affected die out completely. Examination of the root systems of affected trees reveals that the fine fibrous roots die off first, followed by a progressive rotting of the main roots, the damage roughly corresponding in extent to that shown by the aerial parts of the trees. The bark of the dying roots becomes soft and pulpy, and is easily stripped from the wood. Both bark and wood contain hyphae of various fungi, as well as numerous bacteria, but all fungi isolated hitherto have failed to produce symptoms of disease when inoculated into roots of young coffee plants in pots in the laboratory. No positive results have been obtained by burying the dying and dead roots of affected trees around the base of healthy coffee trees on the Government Plantation, Kampala, even after a period of nine months has elapsed. All information obtained to date on this disease, from examination of the plants, from cultures and from inoculations, indicated that no highly pathogenic fungus is responsible, and that the cause must be sought elsewhere. In the case of the trees which are only slightly affected, on some estates good results have been obtained by allowing the trees to throw suckers, and training these to form new trees. Recovery is evidently possible in those cases where the damage to the root system is not too extensive. Until further information is obtained the causation and history of this disease on the coffee tree must remain extremely obscure.

Armillaria Root Rot.—Typical specimens of this disease, with well developed rhizomorphs on the surface of the roots, were sent in from the Semliki Valley. The trees were split into sectors exactly as described in Ceylon on tea. This is the first record, as far as our information goes, of this form of the disease on coffee in Uganda, though it is known here on tea. Previous records of this disease on coffee here are somewhat doubtful, as no rhizomorphs were present.

No reports of serious trouble with other diseases of coffee were received during the year.

TEA DISEASES.

Brown Blight, *Colletotrichum camelliae*, was reported as causing damage to the older leaves of the plants, but hitherto it has not attacked the young shoots to a sufficient extent to become troublesome.

Scabby Leaf, corresponding closely with that described in Ceylon, was recorded during the year, but is also limited to the older leaves.

SWEET POTATO DISEASES.

A large number of diseased tubers were examined during the year. The common fungi found in these were *Diplodia theobromae*, *Rhizoctonia bataticola*, *Fusarium* spp., and a collection of saprophytic fungi common in soil here. Inoculation experiments with sound tubers indicate that *Diplodia* and *Fusarium* are essentially wound organisms, while *Rhizoctonia* can attack sound tubers in the field. The fungus reported last year as related to *Pythium* and causing a wet rot of the tubers has not been met with again, and still remains unidentifiable. At present this crop appears to be remarkably healthy in the neighbourhood of Kampala, where it is extensively cultivated, the proportion of diseased tubers is very small in every plot examined, and diseases of other parts of the plant are of little importance.

OTHER PLANT DISEASES recorded during the year are the following :—

Pythium, or a closely related fungus causing a rotting of cuttings of *Pelargonium* sp., being propagated for essential oil distillation.

Nematospora coryli in the interior of coffee beans.

Peronospora sp. causing defoliation and death of *Ocimum basilicum*; the introduction of this plant into Uganda has so far proved a failure, due solely to attack by this fungus.

Cercospora sesami, causing a severe leaf-spot of *Sesamum* at Serere Plantation.

Alternaria sp. of *A. solani* type, causing a leaf-spot of tobacco.

Rhizoctonia bataticola on roots of many hosts, both native and exotic.

Uromyces sp., causing a canker on the stems of old plants of *Ocimum menthaefolium*.

A wilt disease of *Crotalaria striata* associated with *Fusarium* "tracheiphilum" and other *Fusaria*.

A serious leaf spot and defoliation of *Phaseolus* spp. and *Vigna* spp., due to *Colletotrichum* sp. and *Ascochyta* sp. During some seasons this is so serious as to menace the cultivation of beans at Bukalasa Plantation, very little crop being produced.

Heterodera radiculicola, causing large galls on the roots of *Panax* cuttings.

SUGAR.

Mosaic remains our only disease of economic importance. Red Stripe, *B. rubrilineans*, has recurred in the plants of P.O.J. 2727 in the nursery at Kampala, but has not been discovered as yet on the sugar estates. As this variety is now being discarded for other reasons, it is hoped that the disease will not recur. The cultivation of P.O.J. 2725, 2727 and 2878 has been extended during the year at the expense of Stripe Ribbon on all estates. Unfortunately the promise shown by P.O.J. 2727 in earlier stages of extension has not been borne out by our later experiences with it; it matures rather late under Uganda conditions, taking 18 or 20 months to ripen, and has the extremely undesirable habit of becoming pithy or hollow in the centre of the joints. The juice is rather poor. P.O.J. 2725 has this year arrowed everywhere at nine to eleven months, and has thereby lost favour. The canes of this variety have been shorter than those of other varieties at the time of arrowing. P.O.J. 2878 still shows promise of becoming our standard cane for the near future, as so far it has not shown the undesirable characters of 2725 and 2727. All other varieties of P.O.J. (numbers below 2700) have been discarded, as showing no improvement over Striped Ribbon. Introductions from Mauritius and from the West Indies have without exception proved too susceptible to Mosaic Disease under Uganda conditions to be worth while cultivating, and have been discarded.

LABORATORY WORK.

Most of my time has been devoted to research on Blackarm disease of cotton.

Detailed examination and culture work on the "die-back" of coffee in Toro district were carried out during the year. The larger number of isolations of *Fusarium* spp. obtained from the roots of affected trees have given great trouble in classification, and as a result of these difficulties a preliminary investigation of the occurrence of members of this genus in Uganda has been carried out, with a view to a monograph in the future.

Other work in the laboratory has been confined to examination of specimens of diseases received from outside sources.

HERBARIUM.

About 200 specimens were added to the Mycological Herbarium during the year. Drawings and descriptions of the majority of species represented in the Herbarium were completed during the year, and this work will be continued during 1932 at Kew Herbarium and the Imperial Institute of Mycology during my home leave.

Since the departure of the late Botanist, Mr. J. D. Snowden, the work of the Botanical Herbarium has devolved on me, and about 600 specimens have been provisionally identified, and duplicates sent home to Kew for authoritative determination. In this connection I have to thank the various members of the staff of the Department and of the public who have assisted in the work of collection of Uganda plants, and especially Messrs. Hancock and Fishlock, who made a very valuable collection from the higher parts of Ruwenzori.

C. G. HANSFORD,

Mycologist.

APPENDIX.

FIELD EXPERIMENT ON BLACKARM DISEASE OF COTTON.

The following is a preliminary account of an experiment designed at Rothamsted for trial in Uganda to endeavour to obtain some data capable of statistical examination, on the behaviour of this disease under Uganda conditions. A full account of the experiment and its results is in course of preparation for publication elsewhere.

Lay-out.—The experimental area comprised 16 square plots each consisting of 121 plants spaced 3 ft. by 3 ft., laid out in the form of a 4 by 4 Latin square.

Treatment.—Four samples of seeds were sown :—

A.—Untreated seed as a control.

B.—Seed inoculated by immersion in a diluted culture of *B. malvacearum* for 15 minutes.

C.—Seed delinted in sulphuric acid for 35 minutes; washed, then immersed in dilute corrosive sublimate solution for 30 minutes under a vacuum pump, and finally washed.

D.—Seed dusted with Dupont "Granosan" dust. Each treatment was replicated four times.

Records.—The records were made in the form of a complete plan of the whole experiment for each observation, showing blanks, plants infected with primary infection on the cotyledons, plants with secondary infection on the leaves, and plants with infection on the stem or branches. Plants killed by the disease were marked as such on the plan.

The plots were planted on 6th August at Kampala, and records were taken every two days till 21st September, then twice weekly till 7th October, then weekly till 3rd November, then fortnightly till 13th January. The crop produced by each plant was reckoned as the number of bolls from which cotton was picked, thus attempting to avoid the complications caused by boll diseases and pests. The total crop from each sub-plot was kept separate and weighed at the close of the experiment on 8th February.

Results.—The final analysis at Rothamsted of the records obtained from the experiment has not been completed, but the following indications have been obtained :—

1. The effect of dusting the seed is to promote more rapid germination, and in this experiment a slightly better stand of plants was obtained from dusted seed.

2. If infection per plot be reckoned as "total infection days," *i.e.*, number of infected plants by number of days each was infected before the close of the experiment, then there was significantly more infection on the "inoculated" plots (B), and less on the "delinted" plots (C) than on either the controls (A) or the "dusted" plots (D). There was a slight difference in favour of the dusted plots, but in this experiment of doubtful significance.

3. The secondary spread of the disease took place at a much more rapid rate than had been anticipated, and for next season this form of experiment has been modified to deal with this.

The disease spread from the plants showing primary infection to the surrounding plants, at a fairly slow and even rate until a rapid rise in the middle of October, following a period of greater rainfall. The rate of spread then slowed down till a second peak in the second and third weeks of December, when a rapid spread took place in all treatments, with the exception of one plot of "delinted" cotton which remained completely free from infection till the close of the experiment.

4. The correlation of the direction of heavy rain-storm and the direction of spread of the disease has not been worked out as yet. The direction of spread of the disease was closely similar to that of the flow of surface water during heavy rain; the sole healthy plot remaining at the close of the experiment received no rain-wash from other plots of cotton.

5. The stem form of the disease showed a steady rise in all the treatments until the period 9th—21st December, when it rose rapidly in all plots (except the healthy plot mentioned above).

6. A weekly analysis of the site, origin and state of each individual Blackarm lesion occurring on the experimental plants was made and gave the following totals :—

SITE OF LESIONS.

<i>Treatment.</i>		<i>No. on main stem.</i>	<i>On branches.</i>	<i>On short secondary branches.</i>		<i>On boll walls.</i>	<i>On boll stems.</i>			
Controls (A)	...	14	...	167	...	76	...	31	...	6
Dusted (D)	...	6	...	79	...	48	...	12	...	4
Delinted (C)	...	2	...	44	...	17	...	15	...	1
Inoculated (B)	...	68	...	173	...	79	...	23	...	4

ORIGIN OF LESIONS ON STEM AND BRANCHES.

<i>Treatment.</i>	<i>From petioles.</i>		<i>From stipules.</i>		<i>From bracts of boll.</i>		<i>From other sources.</i>	
A ...	...	248	...	—	...	6	...	3
D ...	...	128	...	1	...	5	...	—
C ...	...	63	...	—	...	—	...	1
B ...	...	302	...	2	...	4	...	6

This shows that by far the greater part of infection on the stem and branches originates in the leaves and extends down the tissues of the petiole as described by me in my Annual Report for 1930.

7. A large mass of meteorological records was taken during the course of the experiment, but no outstanding correlations between any one factor other than rainfall and the spread of disease have become apparent, and such records must be accumulated over a period of years to allow of any conclusions being drawn from them.

8. The yields obtained from the experiment, when corrected for the plant number, indicate that the inoculated seed gave a smaller yield than any of the other treatments, but the experimental error in the present experiment is too large to allow of any discrimination between the treatments A, C and D. For the next season a separate experiment has been designed to obtain more accurate data on the influence of infection on yield.

ANNUAL REPORT OF THE AGRICULTURAL CHEMIST.

GENERAL.

1. The staff has been on duty throughout the year and has been increased by the engagement of two Makerere-trained laboratory assistants. On the whole their work has been satisfactory, but not consistent. They are able to carry out a series of determinations perfectly well for a week or more and then suddenly make the most elementary mistakes. This makes constant close supervision essential. The standard of their work is improving, however, and when they have appreciated the necessity for accuracy and attention to detail they will become very useful assistants.

LABORATORY.

2. The following is a summary of the work carried out in the laboratory during the year :—

SOILS :—					
Mechanical analyses	...	...	...	...	96
Clay analyses	...	...	...	...	25
Carbon and organic matter	...	...	...	...	230
Nitrogen determinations	...	...	...	...	230
Moisture at point of stickiness and loss on ignition	...	...	...	...	274
Reaction	...	...	...	...	280
MISCELLANEOUS : —					
Essential oils	...	...	...	...	12
Cinchona barks	...	...	...	...	13
Stone in mvule	...	...	...	...	9
Waters	...	...	...	...	14
Termite hill earth	...	...	...	...	1
Groundnuts oil content	...	...	...	...	3
Fertilisers	...	...	...	...	4
Alcohols	...	...	...	...	20
Poisons	...	...	...	...	4

3. SOILS.—Most of the soil work carried out has been in conjunction with manurial trials to attempt to find some basis for the correlation of soil type, analytical data and the response to fertilisers in the field.

This work has, however, assisted in the recognition of two broad soil types for mapping purposes, with a third type more or less intermediate between the two. No time has been available for detailed mapping, but it is hoped that when the district books are more complete this work will be facilitated.

In soil survey work it is really necessary to examine virgin soils to be able to fix types. In this country after generations of shifting cultivation it is almost impossible to fix, with certainty, areas of virgin land. Areas now carrying no population have in the past been densely inhabited. Native wars and herds of game, particularly elephant, have brought about big changes in the distribution of the people. The result is that no profile examined can be regarded as virgin soil and the general appearance of most of the profiles suggests that the original soil has suffered from erosion.

The samples examined of the main type show it to be a red loam on a heavy red sub-soil. The depth of this layer varies considerably, with no colour change, from one to fifteen feet and over. Under it is usually a layer of concretions of iron-stone and silica which are sometimes quite loose, more like a water-laid gravel and sometimes completely cemented together and rock-like. This layer also varies in thickness and is in its turn underlaid by a stiff clay.

The other broad type is a very sandy soil which may conveniently be called a lake basin soil as it was almost definitely laid down under water. It occurs in a broad belt all round Lake Kioga, in the Lake George plain, to the east of the Masaka-Bukoba road, and a tongue of it runs from Lake Victoria through Gomba in the Entebbe district. The natural vegetation is short grass and scrub with *Euphorbia candelabra* outstanding. It usually has a thin layer of black sticky organic material on a sandy yellow sub-soil. The sub-soil is tightly packed and often cemented into a pan. The water table is usually fairly high and drainage bad.

Between these two types there is usually a belt of silty loam becoming gradually heavier as one leaves the lake basin type. In the neighbourhood of Ruwenzori, and, possibly, mountains Elgon and Debasien, there are small areas of black volcanic soils which have not yet been examined in detail.

Some typical analyses are given, A being the red loam, B the lake basin soil, and C the intermediate zone.

PHYSICAL ANALYSES.

Sample No.	Ins.	Moisture.	Clay.	Silt.	Fine Sand.	Coarse Sand.	Sticky point.	Loss on Ignition.
A. ... 143 ...	0—6	... 6.5 ...	39.9	... 17.3	... 18.21	... 20.14	... 35.2	... 13.9
B. ... 125 ...	0—9	... 1.4 ...	20	... 15	... 27.25	... 38.9	... 17.7	... 4
C. ... 48 ...	0—9	... 5.6 ...	30	... 10	... 18.9	... 34.1	... 30.0	... 11.6

CHEMICAL.

	Reaction.	% Carbon.	% Nitrogen.	Carbon-Nitrogen ratio.
A. 143	Neutral	3.8	0.354	10.8
B. 125	Acid	0.61	0.082	7.4
C. 48	Acid	2.54	0.192	13.2

These determinations are merely given to give a general idea of the position. When more clay analyses have been carried out, and the data from laboratory and field work are collected, a more complete account of the soils and their responses will be written. At the moment we can say that type A is more suited to permanent crops like tea and coffee and also produces good cotton; type B favours groundnuts, but cotton only in seasons of well distributed rainfall; type C will grow any food crop and cotton, but not permanent crops.

ESSENTIAL OILS.

4. An experimental essential oil still, kindly presented by Messrs. Lever Bros., has been in frequent use during the year both on indigenous and introduced plants. It has worked satisfactorily, except for the reception kettle, which was too shallow to retain all the oil in the distillate and was also difficult to clean between extractions of different plant material. In its place a tall silt cylinder, with four tubulures, was fitted up with good results. The glass receiver has many advantages in experimental work. It can be cleaned with sulphuric-chromic mixture and so freed from the odour of the previous extraction very easily. In addition, the rate of yield of oil can be watched and distillation stopped as soon as it becomes uneconomic.

Small plots of these plants were established by the Botanist on the Kampala plantation and distillation carried out when sufficient material became available. The following is a summary of the results of distillations:—

(a) *Ocimum manthaefolium*.—Indigenous. Yield at least 15 lbs. per acre of good clear oil.

(b) *Ocimum* sp., *Mujaja omunene*.—Indigenous. Yield 30 lbs. per acre.

(c) *Coleus* sp., *Kawamala*.—Indigenous. Yield only about 10 lbs. per acre.

(d) *Hoslundia opposita*, *Kamunyi*.—Indigenous. Yield 12—15 lbs. per acre.

(e) GERANIUM (*Pelargonium radula*).—Introduced. This oil was sent to the Imperial Institute as from *Pelargonium capitatum*. Since then, the plant has been re-determined as above. It yielded 21 lbs. of oil per acre on a single cut, and three cuts a year in this country are possible.

(f) LEMON GRASS (*Cymbopogon citratus*).—This plant was introduced years ago and used along contours and beside the plantation paths to stop erosion. The oil yield was good, but it was not possible to compute yield per acre as the material was not grown in a definite plot.

(g) PATCHOULI.—Yield per acre at least 50 lbs. Two cuts a year are possible, and at 15s. per pound would mean a gross return of £37 10s. per acre per cut.

Samples of all the above oils were sent to the Imperial Institute and the reports are given in the Appendix. It will be seen that the results of distillations of indigenous plants to date are not encouraging but larger samples of oil are being collected for further report. The geranium and patchouli are being planted up on a larger scale to obtain more accurate yield data.

Distillations of *Mentha aquatica* and *Mentha viridis* have also been carried out, and samples of oil will be sent home when sufficient has been collected.

Pelargonium odoratissimum, *Coleus barbatus* and *Vetiver* have been tried, but the yield has been too poor to justify further experiment.

ENFLEURAGE.—An attempt was made to obtain oil of tuberose by enfleurage. In spite of the fact that the pickers were supplied with forceps for picking the flowers and were not allowed to go near the wax, the product resembled “Flor d’Afrique” in odour. Everything points to the conclusion that this method is not suited to native labour and is not economic.

VOLATILE SOLVENTS.—By co-operation with Mr. F. D. West, of Toro, violets were extracted with petroleum ether. The essence concrete had a good odour and the work is being continued with a continuous extraction apparatus.

CINCHONA.

5. The samples of bark from the forestry plantation at Kitubulu, reported on in 1929, showed a very high content of alkaloids. Vegetative propagation from these trees has been started by the botanical section. To expedite the work samples of bark were taken from a further thirteen trees for analysis, with the following results :—

Tree.	Percentage Alkaloids.			Tree.	Percentage Alkaloids.		
A	...	...	5.38	H	...	...	6.60
B	...	...	7.10	*I	...	...	8.42
*C	...	...	9.60	J	...	...	7.57
D	...	...	7.40	*K	...	...	9.20
*E	...	...	9.30	L	...	...	7.67
*F	...	...	9.70	M	...	...	6.92
G	...	...	5.75				

* Trees C, E, F, I and K have been selected for propagation.

TERMITE HILL EARTH.

6. The Protectorate is studded with termite hills which start erosion, entail a loss of cultivated land, and frequently make it difficult to lay out field experiments on the Latin square principle. If the hill is dug out and the earth spread around, practically nothing will grow in that area and the earth bakes, giving a road-like surface. This is particularly noticeable on the Government plantations.

To obtain an idea of the nature of this termite earth, a number of samples were drawn from hills of *Termes bellicosus* and a composite sample analysed.

Mechanical.			Percentage.	Chemical.			Percentage.
Clay	...	...	57.5	Loss on ignition	...	...	11.3
Silt	...	...	7.5	Silica	...	...	56.0
Fine sand	...	...	13.1	Phosphate	...	...	0.129
Coarse sand	...	...	7.9	Potash	...	...	0.51
Moisture	...	...	13.4	Carbon	...	...	0.73
Moisture at point of stickiness			37.30	Nitrogen	...	...	0.088

The low percentage of carbon agrees with that of a normal sub-soil and rules out the possibility that the adhesiveness of termite hill earth is due to an organic cement between the particles. It is not known whether the termite in building merely moistens the earth with saliva or whether it passes through the insect. The low organic matter and nitrogen content indicate that moistening only takes place.

The binding property is undoubtedly due to the high percentages of the fine fractions and silica, particularly silica, the binding properties of which are well known.

The earth is poor in plant foods, and this, together with the compactness of a puddled clay, combines to produce infertility.

The only possible theoretical way of reducing the damage done by termite hills in experimental areas is to dig out the hill, powder the earth, and spread evenly over the whole area in a very thin layer. Then mix evenly with the top soil to allow micro-organisms to assist in the natural weathering processes. A strong-growing green manure crop ploughed in would also assist. This might be practicable for small experimental areas but would not be economic on a large scale. Erosion on a large scale could be checked by digging a trench round each termite hill.

Samples of material from other termite hills will be examined and observation of the habits of the insect continued, as they should undoubtedly be considered from the points of view of soil formation, denudation, and destruction of organic matter.

WATERS.

7. Twelve samples of water taken from various parts of Lake Katwe were analysed at the request of the Director of Geological Survey. The results are published and discussed in the Annual Report of that department.

STONE IN MVULE.

8. The work on this question (Annual Report 1929, page 51) has been continued. The material forwarded as sap in the report was not the true sap of the tree, which is very difficult to obtain. In 1931 the Forest Research Officer forwarded two small samples of true sap and further samples of stone which have been analysed for calcium content.

	Sap				Stone				Mean Stone.
	I.	II.	I.	II.	III.	IV.	Mean Sap.		
CaCO ₃ % in dry matter	18.2	19.7	62.5	78.8	84.1	68.9	3.88		
Si O ₂ in dry matter	0.085	0.092	0.278	1.05	3.12	0.54	2.12		
R ₂ O ₃ in dry matter	0.49	0.57	1.29	0.68	4.72	0.42	3.34		

The samples of sap were collected from the same tree with about five months' interval between collections.

Stone samples were collected as under :—

- (i) Stone in tree.
- (ii) Stone formed near beetle borings.
- (iii) Stone from shake in middle of tree.
- (iv) Stone in tree.

The mean stone-sap ratios show better agreement, particularly in calcium and R₂O₃, indicating a simple drying out of sap. The Forest Research Officer has found welling of sap from beetle workings and stone beginning to form, so the ultimate solution of the problem lies in finding a method of stopping the beetle activity.

GROUNDNUTS.

9. In connection with the work of selection and extension of groundnut cultivation, three samples of nuts were examined for oil content at the request of the Senior Agricultural Officer, Serere.

					Percentage Oil.
(1)	Tanganyika bunch type	...	...	...	46.8
(2)	Serere bunch type	...	...	...	45.5
(3)	Serere spreading type	...	...	...	42.4

The bunch type definitely gives a better yield than the spreading type and also a higher yield per acre (*see Serere Report*), but unfortunately the locust (*Locusta migratorioides*) has also shown a distinct preference for the bunch type.

FERTILISERS.

10. Four local fertiliser materials were analysed, and for comparison an average analysis of farmyard manure is given:—

	Cotton seed ash.		Cotton seed.		Coffee pulp.		Coffee parchment.		Average farmyard manure.
	%		%		%		%		%
Moisture	16.9	...	32.7	...	46.7	...	20.7	...	76.11
Ash	61.2	...	7.9	...	15.1	...	3.8	...	—
Phosphate	11.2	...	1.23	...	0.03	...	0.16	...	0.23
Potash	14.1	...	1.37	...	2.10	...	1.45	...	0.56
Nitrogen	1.28	...	2.21	...	1.13	...	0.44	...	0.55

The best balanced fertiliser is cotton seed, which is about four times as concentrated as farmyard. A general purpose dressing of three tons per acre has given good results.

The sample of cotton seed ash was not completely burnt and contained one per cent of nitrogen. As it is usually to be had for haulage costs it is being tried on tobacco.

POISONS.

11. In connection with locust control work a number of samples of arsenite were examined and also two lots of locusts.

The first sample of locusts had been taken in an area in which poisoned bran had been used. They contained no arsenic. The second sample was obtained where the poison had been dusted on to the grass and the locusts contained arsenic. This seems to indicate that where natural fresh food is available the locust prefers it to the bait material.

INDUSTRIAL ALCOHOL ORDINANCE.

12. During the year I administered the above Ordinance and rendered a separate report. In the course of this work samples of alcohol, denatured in various ways, were examined in order to find a cheaper method of making the spirit unpotable. As a result of this work it was decided not to recommend a modification of the rules.

FIBRES.

13. A large number of fibre plants are indigenous to this country and others have been introduced and do well. The main costs in the production of fibre for the market are those of retting. Some preliminary experiments have been carried out to find a chemical method of retting. Solutions of sodium carbonate, caustic soda and sodium sulphite of $\frac{1}{2}$, 1, 2 and 5% have been used on stems of Sunn hemp. The more dilute solutions have not assisted materially in the loosening of the fibre and the stronger solution of 5% broke up the material, but the resulting fibre was weak. If a digester and boiler can be obtained trials will be made with weak solutions at high steam pressure.

FIELD EXPERIMENTS.

14. The manurial experiments on coffee mentioned in my Annual Report for 1930 were continued in 1931 with the following results. Yields are given in cwts. of fresh cherry per acre.

Treatments:—

A.	Diammonphos	...	...	...	...	180 lbs. per acre.
B.	Superphosphate	...	...	...	...	2 cwts. „ „
C.	Sulphate of Potash	...	...	...	...	2 „ „ „
D.	Sulphate of Potash	...	...	...	...	2 „ „ „
E.	Diammonphos	...	...	...	...	180 lbs. „ „
F.	Sulphate of Potash	...	...	...	...	2 cwts. „ „
	Superphosphate	...	...	...	...	2 „ „ „
F.	No treatment.	...	...	...	...	

RUBONA ESTATE (F. D. WEST, ESQ.).

Treatments	...	A	B	C	D	E	F	Mean.	S.E.M.D.	Significant Difference.
Yield	...	80.5	52.9	47.2	61.5	59.2	52.2	58.9	9.1	20.27
Percentage of Mean	...	136.6	89.8	80.2	104.4	100.5	88.6	100	15.46	34.4

Diammonphos is definitely better than all treatments except D, which also contains diammonphos.

KAHANGI STATE (A. S. WATKINS, ESQ.).

Treatments	...	A	B	C	D	E	F	Mean.	S.E.M.D.	Significant Difference.
Yield	...	7.35	4.53	4.53	4.59	4.2	4.92	5.03	1.25	2.78
Percentage of Mean	...	146.2	90.2	90.2	91.2	83.4	99.1	100	24.8	55.3

By the "Z" test there is no significance, but again there is a strong indication that the diammonphos is beneficial.

TABLE II.
SAMPLES TAKEN THREE YEARS AFTER PLANTING, 1931.

Estate.	Acidity.	Organic matter.		Nitrogen.		C/N ratio.		Remarks.
		%		%		%		
B	... Acid	...	8.25	...	0.333	...	14.3	Badly affected.
B	... "	...	6.29	...	0.312	...	11.7	Coffee better than 1.
B	... V. acid	...	5.81	...	0.269	...	12.5	Badly affected area near old house.
C	... Slightly acid	...	5.51	...	0.304	...	10.5	Good coffee.
C	... V. acid	...	4.75	...	0.252	...	10.9	Bad patch of coffee.
A	... Slightly acid	...	7.20	...	0.350	...	11.9	Bad area.

These figures show no positive correlation between any one factor and degree of attack. To complete the data the clay fractions of each of these soils were extracted, fused and analysed. The figures are given in Tables III. and IV., and it is noteworthy that the top-soil of sample 395 gives higher phosphate and potash than 396, two samples from bad and good fields on the same estate.

TABLE III. (SAMPLED 1928).
CHEMICAL COMPOSITION OF CLAY FRACTIONS OF TORO SOILS.

Soil.			Loss on Ignition.	SiO ₂	Fe ₂ O ₃	Al O ₃	SiO ₂ / Al ₂ O ₃	Total P ₂ O ₅	Total K ₂ O
			%	%	%	%	Mol.	%	%
Estate A (208)	... 0 ins.— 6 ins.		19.0	36.9	14.1	30.2	2.08	0.189	0.266
	6 " —12 "		15.7	36.9	16.1	32.3	1.95	0.147	0.326
	over 12 "		—	44.6	12.1	40.2	1.88	0.258	0.261
" C (211)	... 0 " —12 "		17.4	37.4	10.2	26.7	2.38	0.217	0.244
" B (216)	... 0 " — 8 "		19.6	39.3	13.6	26.9	2.49	0.108	0.351
	8 " —15 "		16.5	38.4	14.4	30.2	2.41	0.071	0.180
" E (219)	... 0 " — 9 "		19.5	39.3	11.9	29.7	2.25	0.111	0.428
	9 " —18 "		15.3	36.0	12.2	32.5	1.88	0.069	0.539
" E (221)	... 0 " — 8 "		18.8	36.4	14.0	30.0	2.06	0.207	0.707
" F (243)	... 0 " — 9 "		21.8	43.8	9.3	25.2	2.96	0.436	1.010
	9 " —18 "		16.6	41.3	9.3	35.0	2.00	0.244	0.667

TABLE IV. (SAMPLED 1931).

Soil.			Loss on Ignition.	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	SiO ₂ / Al ₂ O ₃	Total P ₂ O ₅	Total K ₂ O	Remarks.
			%	%	%	%	Mol.	%	%	
Estate B (395)	... 0 ins.— 8 ins.		20.3	37.4	9.4	32.6	1.96	0.885	1.120	Bad coffee.
	8 " —15 "		16.0	39.6	12.4	32.4	2.08	0.512	0.490	
" B (396)	... 0 " — 8 "		18.2	39.6	11.1	32.1	2.09	0.536	0.705	Good coffee.
	8 " —15 "		14.1	40.6	13.5	33.0	2.09	0.185	0.830	
" B (397)	... 0 " — 8 "		19.1	35.0	13.9	28.8	2.12	0.256	0.975	Bad coffee.
" C (398)	... 0 " —12 "		20.1	42.0	10.4	31.8	2.25	0.226	0.893	Good coffee.
	1 ft.— 2 ft.		15.8	37.8	14.2	32.0	2.01	0.071	0.336	
" C (399)	... 0 ins.—12 ins.		20.5	36.8	9.95	31.8	1.97	0.212	0.440	Bad coffee.
	1 ft.— 2 ft.		15.1	39.2	13.4	29.8	2.24	0.075	0.825	
" A (400)	... 1 " — 2 "		15.5	37.7	16.8	30.6	2.09	0.064	0.281	Bad coffee.
Sub-soil from under dead tree.										
" A (401)	... 0 ins.—12 ins.		17.1	35.9	15.1	30.9	1.98	0.093	0.214	Bad coffee.
	1 ft.— 2 ft.		15.8	36.9	17.3	30.6	2.05	0.072	0.329	

In September small plots on these estates were treated with cotton seed ash, potassium sulphate. Further plots are to receive ammonium sulphate. If there should be a sulphur deficiency, as in Nyasaland on tea, it should be shown up by these plots. In addition, spraying with Bordeaux and Carbide sprays are being tried as they have proved effective against leaf-fall in Kenya.

Finally, soil is being obtained from one of the most badly affected estates for a series of pot experiments, using combinations of fertiliser.

W. S. MARTIN,
Agricultural Chemist.

ANNUAL REPORT OF THE ECONOMIC BOTANIST.

Mr. J. D. Snowden was in charge until the end of May, when he proceeded home on leave, and the writer then took over the duties, with the exception of the Herbarium work, until the end of the year.

COFFEE.

2. *Selection*.—A total of 65 trees has now been selected for further observations. The selections consist of 49 *Coffea robusta* and 16 *C. arabica* trees growing within a radius of fifty miles of Kampala; other selections will be made as promising trees are noted and observations continued on them, over a period of at least four years before the final selections are made.

3. Samples of the crops of some of the *Robusta* selections were forwarded to the Imperial Institute for examination and report of their roasting and liquoring qualities. The reports on a few of the samples were fairly good, but the remainder were not so favourable; however, as *Robusta* is a bulk coffee, the cup quality is of minor importance, yield and size of berry being the main factors.

4. *Vegetative Propagation*.—Considerable attention has been given to the vegetative propagation of coffee by grafting; an endeavour is being made to raise nine grafted plants of each selected tree. These trees are being planted out in groups on the Kampala Plantation for the purpose of obtaining a supply of self-fertilised seed which will be obtained by isolating the groups with netting to prevent cross pollination and also to observe the suitability of the various stocks for grafting.

5. The method employed for grafting which has been found most successful is cleft or split grafting. The graft is tied with cotton wick which is not greased or waxed, but, in order to obtain success, it is essential that the stock and scion are covered with an inverted tube. Previously, glass test tubes were used, but in July an experiment was carried out with waxed-paper tubes and these were found equally successful as the glass ones with the additional advantage of cheapness, for approximately 120 wax-paper tubes can be made for the cost of three glass tubes. The tubes are made of old newspapers, the pieces of paper being cut to the size of 8 ins. by 6 ins., and then rolled around any cylindrical object of about one inch in diameter, tied at the top with twine and completely immersed in melted paraffin wax.

6. The stocks used for grafting have consisted of seedling *Robusta*, *Liberica* and *Excelsa* coffees, the results of the successes obtained being as follows:—

Stocks used,	<i>Robusta</i> Grafts.			<i>Arabica</i> Grafts.		
	Successes.			Successes.		
		%			%	
<i>Robusta</i>	...	68	...	...	38	...
<i>Excelsa</i>	...	76	...	...	35	...
<i>Liberica</i>	...	69	...	...	100	...

The above figures indicate that greater success is obtained with *Excelsa* stock for *Robusta* and that *Liberica* is more successful as a stock for *Arabica*; this result, however, is not conclusive, further experiments being necessary to prove the suitability of stocks. In the rate of growth and general appearance of the grafts no difference is noticeable at present on the various stocks.

7. An experiment has also been carried out in the field, the object being to replace poor yielders by grafting with scions obtained from selected trees. For this purpose a number of *Robusta* trees were stumped in August, 1930, and on these there were produced a large number of shoots which were gradually thinned out until two strong upright shoots were left on each stump. When the shoots had obtained the required maturity they were cleft grafted with scions of selected *Robusta* trees. The results were most satisfactory, and the rate of growth has been very good, for the upright shoots which were produced from the scions have reached a height of 2½ feet in ten months.

HEVEA RUBBER.

8. *Tapping*.—All the tapping experiments at Kampala and Entebbe which were being carried out to find the best yielders have now been concluded, and the highest yielding trees have been pollarded to supply material for budding purposes. A total of fifteen trees was selected on the Kampala Plantation and twelve trees in the Botanic Gardens, Entebbe.

9. *Budding*.—A total of 35 trees was budded at the end of 1930, of which 20% were a success. No budding was done during the year as suitable budwood from the selected trees was not obtainable.

QUININE.

10. A plot of quinine at Kitubulu, near Entebbe, grown from seed received by the Forest Department from Java in December, 1921, under the name of *Cinchona Ledgeriana*, and recently determined by Kew as *Cinchona josephiana*, Wedd, was taken over for experimental purposes during the year. The object is to raise vegetatively a sufficient number of trees of which samples of bark had been forwarded to England and had been favourably reported upon. For this purpose a large number of seedlings have been raised from seeds which were collected from an adjoining plot and these are being grown on as stocks for grafting when they have obtained a suitable size.

11. *Cuttings*.—Numbers of cuttings of each of the selected trees have been taken and various methods have been tried to strike them; the success of same, however, has not been very satisfactory.

12. *Grafting*.—This has been carried out on a number of trees in the plot and although the trees are rather large to use as stocks, better success has been obtained than with cuttings.

13. The method which has been found most suitable is side grafting, the incision made on the stock for inserting the scion consisting of a three-sided square cut similar to that used for budding rubber. Both a "T" cut and a cut which consisted of three parallel incisions about two inches long with an incision across the top were tested, but without success.

14. The main condition for grafting quinine in this way is that the bark should be easily detachable. The size of the stock is not a very important factor, but better results are obtained from stocks which are about the thickness of a spade handle. The scions should be about the thickness of a lead pencil and cut just below a pair of dormant buds with a tapering cut to the length of about $1\frac{1}{2}$ inches.

ESSENTIAL OIL PLANTS.

15. A good deal of work has been done throughout the year on the raising of essential oil plants, an endeavour being made to obtain an adequate supply of material of each sort for testing purposes. Large numbers of plants have been raised from seed and cuttings and planted out in plots on the Kampala Plantation.

16. Numbers of new introductions have also been made of plants and seeds and these, where possible, have been propagated.

17. Distillations have been made of all plants of which material has been available and where sufficient oil has been obtained, this has been forwarded to England for report. The results of same and further details concerning the distillations made, will be found in the Agricultural Chemist's report.

18. The following is a list of all essential oil plants that are at present under trial on the Kampala Plantation.

EXOTICS.				REMARKS.		
<i>Pelargonium radula</i> —"Rose Geranium"	..			Large plot planted, distillations have been made with material.		
<i>P. sp. var. Attar of Roses</i> —"Rose Geranium"				Plot planted out, insufficient material at present for distillation.		
<i>P. capitatum</i> —"Rose Geranium"	...			Stock consisted of one plant from which a number of plants have been raised and planted out. Insufficient material available at present for distillation.		
<i>. fragrans</i>	...	...	...	do	do	do
<i>P. pinnatum</i>	...	...	...	do	do	do
<i>P. odoratissimum</i> —"Nutmeg Geranium"	...			Large plot planted, plants raised from seed. Distillations have been made with material.		
<i>Pogosemon patchouly</i> —"Patchouli"	...			Plots planted out, distillations have been made with material.		
<i>Lippia citriodora</i> —"Lemon-scented Verbena"				Plot planted out, insufficient material at present for testing.		
<i>Cymbopogon citriodora</i> —"Lemon Grass"	...			Planted around plots, distillations have been made.		
<i>Mentha viridis</i> var.—"Scented Mint"	...			Large plots planted, distillations made with material.		
<i>Lavendula spica</i> —"Spike Lavender"	...			Plot planted, doubtful if of any use, never produced flowers.		
<i>Lavendula vera</i> —"Lavender"	...	...	...	do	do	do
<i>Thymus</i> sp.—"Thyme"	...	...	...	Plot planted, insufficient material at present for distillations.		
<i>Polianthus tuberosa</i> —"Tuberose"	...			Large plot planted, material tested by enfleurage.		
<i>Rosmarinum officinalis</i> —"Rosemary"	...			Small plot planted, plants raised from seed. Not yet tested.		
<i>Reseda odorata</i> —"Mignonette"	...	...	...	A few plants raised from seed, not very successful.		
<i>Vetiveria zizanoides</i> —"Vetiver"	...	...	...	Large plots planted, material has been tested.		
<i>Acacia</i> sp.—"Mimosa"	...	...	...	Plot planted, not sufficient material at present for testing.		
<i>Coleus</i> sp.	...	...	...	Plot planted, distillations have been made with material.		
INDIGENOUS.						
<i>Blumea lacera</i> —"Kulya"	...	...	...	Plot planted, not sufficient material available at present for distillation.		
<i>Coleus barbatus</i> —"Kyawamala"	...			Plot planted, distillations have been made with material.		
<i>Coleus</i> sp.—"Kyawamala"	...	...	...	do	do	do
<i>Coleus</i> sp.—"Mubiri"	...	...	...	Plot planted, not sufficient material available for testing.		
<i>Mentha aquatica</i> —"Kagogo"	...	...	...	Large plot planted, distillations have been made with material.		
<i>Ocimum menthaefolium</i> —"Kakubansiri"	...	...	...	do	do	do
<i>Ocimum</i> sp.—"Mujaja Omunene"	...	...	...	do	do	do
<i>Hoslundia opposita</i> —"Kamunye"	...	...	...	do	do	do

FIXED OILS.

19. *Elaeis guineensis*, "Oil Palm."—Trial plots have been planted at Serere and at Wanyange in Busoga during the year, also the recording of individual yields of the palms in the plot at Entebbe has been continued. This plot was planted by the Forest Department in 1921, and individual records of the seed production of each palm were commenced in January, 1928.

20. The following new varieties were received from the Agricultural Department, Nigeria, in November, and have been sown in the nursery beds at Entebbe :—

Ordinary thick shelled variety, tree No. 222.
 " thin " " " " " 340.
 Green fruited thick shelled variety, tree No. 341.
 " " thin " " " " 384.

The seeds were of a much smaller size than any that are produced by the palms in the plot at Entebbe, the largest being about the size of a small walnut.

21. *Aleurites* spp., "Tung Oil."—The nine plants of *Aleurites fordii* and one plant of *A. montana* planted out on the Kampala Plantation in 1930 have made good progress; these plants were raised at Entebbe from seed received from Amani, Tanganyika, in May, 1929. A further consignment of seeds was received from Kenya during the year and was sown at Serere and Bukalasa.

22. *Hydnocarpus* spp.—The plot of *H. Wightiana* on the Kampala Plantation, which was raised from seed received from India in July, 1926, and planted out in April, 1927, is now bearing a heavy crop of fruit. The crop, however, which has been on the trees throughout the year, appears very slow in ripening, only a very few of the fruits having matured up to the present.

23. The plot of *H. Wightiana* in the Botanic Gardens, Entebbe, which was raised from seed received from India in July, 1926, and planted out in May, 1927, is just beginning to flower and set fruit.

24. The plots of *H. anthelmintica* at Kampala and Entebbe, which were raised from a consignment of seed received from the Medical Department in December, 1927, have not flowered or fruited yet, but the trees are making good growth. The trees were planted out at Kampala in April, 1929, and at Entebbe in March, 1929.

25. *Carapa grandiflora*.—A large consignment of seeds was received from the Forest Department in July, the seeds being sown at Kampala, Bukalasa and Entebbe. Only a few of the seeds have germinated up to the present.

SPICES AND CONDIMENTS.

26. The plot of vanilla on the Kampala Plantation, which was cleaned up and replanted during the year with fresh cuttings, has now established itself and made good progress.

27. The seed of Sweet Basil, Caraway, Dill and Coriander which were received from France at the end of last year have been tried out, but the first three have not been very successful when sown in the open; the Coriander, however, has been quite a success and fair-sized plots have been sown with it.

FIBRES.

28. The fibre plants which are at present under trial include the following:—Manila Hemp, *Musa textilis*; Sunn Hemp, *Crotolaria juncea*; Rozelle, *Hibiscus sabdariffa* var. *altissima*; Ramie, *Boehmeria nivea*; Jute, *Corchorus capsularis*; and *Asclepias semilunata*. Samples of fibre have been obtained of Manila and Sunn Hemp and have been forwarded to England for report. The other fibres will be tested as material becomes available.

GREEN MANURES AND COVER CROPS.

29. A number of plants are being used as green manure and cover crops on the plantations, such as:—*Crotolaria striata*, *C. juncea*, *C. alata*, Bengal beans, Sword beans, Soya beans, buckwheat, *Indigofera* spp., *Dolichos lablab*, *Centrosema pubescens*, etc., and new introductions which include field pea, Niger oil, velvet beans, etc., are being tried out in special plots.

GRAZING AND FODDER GRASSES.

30. A total of 24 plots of the most promising grasses has now been established in one-hundredth of an acre plots on the Kampala Plantation. The plots have done well and where possible records of the weight of the cuttings of fresh green material were made, but no useful information could be obtained owing to the locusts, which on several occasions ate off all the young growth on the plots.

31. The following are the records that were obtained :—

					Weight of fresh green material.
					lbs.
<i>Hyparrhenia Ruprechtii</i>	...	...	...	...	50
<i>Hyparrhenia cymbaria</i>	...	...	...	...	162
<i>Setaria Chevalieri</i>	...	...	...	...	466
<i>Panicum maximum</i>	...	...	...	...	82
<i>Panicum trichocladum</i>	...	...	...	...	132
<i>Rhynchelytrum roseum</i>	...	...	...	...	91

FRUIT TREES.

32. Very little time was available for the propagation of the citrus trees which were introduced in 1929. A few seedling sour oranges were, however, successfully budded with budwood obtained from the tangerine, "Beauty of Glen Retreat," also one of the "Washington Navel" oranges was rebudded, it being found that the original bud had died, leaving only the stock growing.

33. The undermentioned fruit trees have been raised from seed received during the year, the plants being planted out on the Kampala Plantation and at the Botanic Gardens, Entebbe.

	<i>Seed received from</i>		
<i>Achras sapota</i> , "Sapodilla Plum" ...	Department of Agriculture, Trinidad.		
<i>Averrhoa bilimbi</i> , "Bilimbi" ...	do	do	do
<i>Chrysophyllum cainito</i> , "Star Apple" ...	do	do	do
<i>Mammea americana</i> , "Mamee-Apple" ...	do	do	do
<i>Lansium domesticum</i> var. <i>duku</i> , "Duku" ...	Botanic Gardens, Singapore.		
<i>Castanea vesca</i> , "Spanish Chestnut" ...	Andrieux & Co., France.		
<i>Carica papaya</i> vars. "Papaw" ...	H. E. The Governor.		

Three root cuttings of "Cerimon," *Monstera deliciosa*, were also received, two of which have taken and have been planted out in the fernery in the Botanic Gardens; these were received from Aburi, Gold Coast.

34. Other seeds have been received, but they have not germinated up to the present. They include:—*Eugenia floribunda* vars., *Bertholletia excelsa*, *Lucuma mammosa*, *Eugenia malaccensis*, *Blighia sapida*, and *Garcinia Hanburyi*.

35. A consignment of eight date palm offsets was introduced from Egypt in July; they consist of two each of *Siwi*, *Amhat*, *Hayani* and *Amri* varieties of date palms. The two former varieties were planted out on the Kampala Plantation and the two latter varieties were forwarded to the Ngetta Plantation, Lira. Those on the Kampala Plantation have made very little progress since they were planted out.

TEA.

36. No special work has been done on this crop during the year with the exception of the introduction of four new varieties which were received at the end of the year from Dangri and Dhonjan Tea Seed Company, India. The varieties consist of *Dangri manipuri*, *Dhonjan Assam*, *Betjan Assam* and *Raighur*; the seeds have now been sown in nursery beds at Kampala.

CONCLUSION.

37. For the contributions of the various economic and decorative plants and seeds which have been received, thanks are due to the following:—

The Director, Royal Botanic Gardens, Kew.
 The Director, Department of Agriculture, Trinidad.
 The Curator, Royal Botanic Gardens, Peradeniya, Ceylon.
 The Director, Eala Botanic Gardens, Belgian Congo.
 The Superintendent, Aburi Agricultural Station, Gold Coast.
 The Superintendent, Botanic Gardens, Singapore.
 The Director of Agriculture, Ibadan, Nigeria.
 The Ministry of Agriculture, Giza, Egypt.
 Dangri and Dhonjan Tea Seed Co., Calcutta.

E. A. RUCK,

Plantation Manager.

ANNUAL REPORT ON THE GOVERNMENT PLANTATION, KAMPALA.

WEATHER.

The total rainfall during the year was 55·67 inches, an increase of 9·61 inches over last year's figure. This represents 6·46 inches more than the average for the last twenty years and 7·00 inches more than the average for the last six years.

CROPS.

COFFEE.

Plot No. 1.—This plot contains a number of different types of coffee plants which are mostly well-established trees. The hybrids and grafts planted out in 1930 have grown satisfactorily, and eighty-five Java *Robusta* seedlings were planted out during 1931. These were grown from seed imported from Java by the Botanist.

The rows of *Leuceana glauca* which were planted every five feet across the contour of the plot in 1930, have effectively stopped a great deal of the wash which used to occur. During the year, the plants had to be cut back three times in order to prevent them from seeding, and in this way quite a fair bulk of green material was added to the soil.

Plot No. 3.—Arabica Pruning Experiment.—The object of this experiment is to test the value of the three general pruning systems by comparing the yields of cherry picked from similar sub-plots under each pruning system. The plot is approximately one acre in area and is divided into twenty sub-plots. The *Arabica* trees are spaced 10 ft. by 10 ft. and were originally planted in August, 1924. Shade is given by rain trees (*Pithecolobium saman*) spaced about 40 ft. Seven sub-plots are pruned on the single stem method (A), seven on the Agobiada system (B), and six sub-plots on the multiple stem method (C). The fruits are picked as they become ripe and are immediately weighed. The results to date are as follows. :—

TABLE A.

DATA OF COFFEE CHERRY PICKED FROM PRUNING EXPERIMENT PLOT NO. 3, 1931.

Method.	Sub-plot No.	1927. lbs.	1928. lbs.	1929. lbs.	1930. lbs.	1931. lbs.	Total for last 5 years. lbs.
SINGLE STEM "A"	1	19'84	11'22	34'41	46'72	124'94	237'13
	2	20'55	20'78	22'19	104'78	55'00	223'30
	3	13'80	15'22	23'86	70'72	69'47	193'07
	4	14'70	32'16	15'91	81'34	79'62	223'73
	5	13'58	18'06	47'86	90'00	91'94	261'39
	6	15'56	10'56	65'97	58'44	167'78	318'31
	7	15'61	23'56	14'28	42'94	144'16	240'55
TOTAL		113'59	131'56	224'48	494'94	732'91	1,697'48
AGOBIAIDA "B"	1	14'72	6'91	27'50	75'16	115'00	239'29
	2	30'88	17'75	61'37	99'22	114'02	323'24
	3	25'23	18'13	72'81	77'72	188'75	382'64
	4	20'22	14'31	81'00	90'13	165'81	371'47
	5	8'06	9'19	51'94	71'87	125'88	266'94
	6	12'39	8'63	51'84	130'00	177'41	380'27
	7	11'23	8'56	37'03	78'72	126'50	262'04
TOTAL		122'73	83'48	383'49	622'82	1,013'37	2,225'89
MULTIPLE "C"	1	7'20	6'41	15'60	59'53	112'53	201'27
	2	5'58	12'56	23'47	83'34	112'59	237'54
	3	8'45	17'50	48'39	98'41	144'44	317'19
	4	3'00	11'78	29'41	104'22	125'97	274'38
	5	4'44	14'03	47'72	88'86	142'47	297'52
	6	7'11	13'87	25'48	172'28	220'62	439'36
TOTAL		35'78	76'15	190'07	606'64	858'62	1,767'26

For purposes of comparison (there being seven sub-plots under "A" and "B," and only six under "C") the average yield per sub-plot under the multiple stem system has been calculated and added on the total for the last five years.

A fair estimate is obtained in this way on the supposition that there were seven sub-plots under the multiple stem system. The total yields for "A" and "B" and the revised figure for "C" are appended below :—

Method.	Total for last 5 years.					
						lbs.
Single Stem "A" ...	...	...	...	...	...	1,697.48
Agobiada "B" ...	...	...	...	...	...	2,225.89
Multiple Stem "C" ...	...	...	...	...	...	2,051.80

Plot No. 4.—Coffea Robusta Selections and Pruning Experiment.—Coffee *Robusta* selections were planted up in 1930, spaced 8 ft. by 8 ft. In 1931 a pruning experiment was laid down as outlined below.

There are six methods of pruning, in quadruplicate, the methods being briefly as follows :—

A. *Single Stem.*—In this method every alternate tree was capped at 2 ft. and one sucker allowed to grow up to form the main stem. The other trees in the row were not capped. In all cases, under this method, the trees will be allowed to develop to a height of 5–6 ft., when they will be topped and kept down to that height. Pruning consists of removing all suckers from the main stem, trimming up the lower primaries, and thinning out the secondaries where necessary.

B. *Agobiada.*—The original stem was bent over and pegged down. This induces suckers to arise from the base of the stem. Three or four of these are selected and trained outwards by the insertion of wooden pegs. The lower primaries of the main stem are removed so as to allow full development of the suckers.

C. *Costa Rica Multiple Stem.*—The young trees are capped at 18 ins. and two suckers are permitted to develop, all others lower down being removed. These two suckers are, as far as possible, trained outwards and allowed to grow and are topped at 18 ins. As a result two more suckers develop, these in turn being capped at 18 ins. There are, therefore, three cappings altogether, which should result in a tree with eight terminal suckers.

D. *Modified Costa Rica Method.*—This method is identified with the Costa Rica multiple stem system, with the exception that after the last, or third capping, only one sucker is allowed to develop. In this method, therefore, the final result should produce a tree with only four terminal suckers.

E. *Free or Open Multiple Stem.*—The young trees are allowed to grow naturally and any suckers up to three or four arising from the base are trained outwards. If, however, the young trees do not produce suckers naturally, they are cut back to about 18 ins., and suckers are thereby induced to develop. In such cases the main stem which has been capped is trained on the single stem method. This system is similar to the Agobiada method in results, but the original stem is not bent over.

F. *Kinawa.*—All trees are capped at 18 ins. and three uprights are permitted to grow from this point. These are later capped at 18 ins., and two suckers arise from each as a result. These suckers are in turn capped at 18 ins.

Remarks.—The first pruning took place on 14th May, 1931, and consisted chiefly of removing any suckers on the single stem trees. Those trees under the Agobiada system had been pegged down a few weeks before. Subsequent pruning took place in June, August, September, November, and December. By the end of the year, most of the trees had responded well to their respective pruning methods. By that time, every alternate tree in the single stem lines was sufficiently developed to be cut back to 18 ins., and one sucker only was permitted to develop to form the main stem. Under the Agobiada system a sufficient number of suckers was produced in nearly all cases, after bending over the original stem, to permit of the selection of three well developed and conveniently placed suckers. These have been trained outwards by the insertion of wooden pegs.

Some of the trees being pruned on the two multiple stem systems have produced suckers of unequal length, owing to the fact that after being capped at 18 ins. one of a pair remained dormant for a longer period than did the other.

In the free or open multiple stem system, quite a number of trees, had to be capped in order to produce suckers from the base. In such cases, the capped stem is further trained as a single stem.

The plot was undersown with *Crotalaria alata* in March, and this was dug under in September. A sowing of beans was turned under as a green manure in November, and the plot was mulched with elephant grass (*Pennisetum purpureum*) in December.

Other Coffee Plots.—A number of the Botanist's coffee grafts were planted out in the top part of plot No. 2. The "No. 9" *Robusta* selection growing in plot No. 7 B, originally planted in 1918, has again been used as the main supply of seed for distribution and for planting in the nursery. The plot was green manured with beans early in the year, and later undersown with Sword beans (*Canavalia ensiformis*) as a cover crop.

No special work has been carried out on the other coffee plots, but all have been pruned when necessary.

TEA.

Plot No. 11.—This plot was terraced and planted up with Assam indigenous tea in June, 1929. Owing to the very poor stand obtained, the plot received a dressing of four tons of cotton seed in April which was placed at the bottom of trenches dug across the plot. The plot was then planted up with *Centrosema pubescens* which produced a good, thick cover. Since the new road, proposed by the Town Planning Committee, will cut through this plot, no further efforts will be made to establish tea in this area.

Plot No. 32.—Up till the present this plot has been used exclusively for plucking, although two-thirds of the area has now been allowed to go to seed. This was found to be expedient owing to the fact that the old seed plot, near the plantation house, is now no longer within the plantation boundary, and will shortly be used for building sites.

Plot No. 25.—This area is divided up into thirty-two sub-plots each containing thirty-six trees. The varieties planted are Kaline, Manipuri, Thanai, and Assam Indigenous, and all have been allowed to go to seed.

Hydnocarpus Wightiana—*Plot No. 19.*—These were planted out in April, 1927, and subsequent growth has been good. Many of the trees came into flower in 1930 and have produced fruits during the past year. Out of the 204 trees, 41% are males and 32% are female trees, the remainder not having been yet determined. The fruits are hard and velvety and remain on the trees for several months in this state. When ripe they become soft and fall off. The seeds are being kept, and when a sufficient number has been collected, will be forwarded for test purposes. Individual yields are being kept.

Hydnocarpus anthelmintica—*Plot No. 11 A.*—These were planted out in 1929, and have grown well, but no fruits have yet been produced. The plot was undersown with *Crotalaria alata* in October.

ESSENTIAL OIL PLANTS.

The following essential oil plants have been grown in small amounts on the plantation:—*Pelargonium* spp., *Pogostemon patchouly*, *Lippia citriodora*, *Thymus* spp., *Coleus* spp., *Mentha aquatica*, *Lavendula spica*, *Lavendula vera*, *Polianthes tuberosa*, *Vetiveria zizanioides*, *Reseda odorata*, *Acacia* spp., and *Ocimum* spp. A half-acre plot of Frangipanni has also been maintained.

Introduced Citrus—*Plot No. 15.*—A number of imported citrus trees was planted out in May, 1929, as follows:—

- | | |
|---|--------------------------------------|
| 1. Tahitian lime (seedless). | 8. Orange, "Valencia Late." |
| 2. Tangerine, "Emperor." | 9. " " "Du Roi." |
| 3. West Indian lime. | 10. " " "Golden Buckeye." |
| 4. Tangerine. | 11. Grape fruit, "Marsh's Seedless." |
| 5. Tangerine, "Beauty of Glen Retreat." | 12. " " " " " " |
| 6. Orange, "Pineapple." | 13. " " " " "Royal." " |
| 7. " " "Washington Navel." | 14. Tangerine. |

Two trees of each kind were planted out, but one of the trees of No. 14 has since died.

Nos. 1—11 were received from South Africa and the remainder from Jamaica. All have done well and have produced fruits, but these have been kept down, and the flowers taken off to prevent over production in the early stages. An undergrowth of *Centrosema pubescens* has been maintained throughout the year.

Coffee Germination Experiment.—An experiment was carried out on the plantation to obtain some information about the length of time that coffee seed should be dried when intending to keep it for future planting.

Method.—The methods employed consisted essentially of drying samples of coffee seed for varying periods, both in the sun and in the shade. After each sample had been dried, the seed was stored for two weeks and then planted in the nursery beds.

A bulk sample of "No. 9" selection *Robusta* seed was chosen, and after being pulped and fermented, samples of 200 seeds each were taken and dried for varying periods of time. These samples were in no way specially selected, although all obviously diseased or infected seed was discarded.

The results obtained are given in Table B.

TABLE B.

Sample of 200 seeds.	Drying period. No. of days in the sun and then		No. of days in shade.	Germination. %	Sample of 200 seeds.	Drying period. No. of days in the sun and then		No. of days in shade.	Germination. %
1.A ...	1	...	4	85	4.C ...	4	...	5	11
1.B ...	1	...	6	85	4.D ...	4	...	8	24
1.C ...	1	...	8	54	5.A ...	5	...	0	$\frac{1}{2}$
1.D ...	1	...	11	70	5.B ...	5	...	2	0
2.A ...	2	...	3	38	5.C ...	5	...	4	$1\frac{1}{2}$
2.B ...	2	...	5	30	5.D ...	5	...	7	1
2.C ...	2	...	7	34	6.A ...	6	...	0	0
2.D ...	2	...	10	26	6.B ...	6	...	1	$\frac{1}{2}$
3.A ...	3	...	2	50	6.C ...	6	...	3	0
3.B ...	3	...	4	50	6.D ...	6	...	6	0
3.C ...	3	...	6	25	7.A ...	7	...	0	0
3.D ...	3	...	9	35	7.B ...	7	...	0	0
4.A ...	4	...	1	16	7.C ...	7	...	2	0
4.B ...	4	...	3	15	7.D ...	7	...	5	$\frac{1}{2}$

Sample of 200 seeds.	Drying period. No. of days in shade only.		Germination. %
E ...	...	5	85
F ...	...	7	83
G ...	...	9	74
H ...	...	12	70

In all cases, the seed having been stored for two weeks, no sign of mouldiness was apparent.

Results.—The germination figures recorded show clearly that such periods of four, five, six and seven days in the sun are too long. The best germination occurred in those cases where the seed had either been dried in the shade only or else for one day in the sun and then in the shade.

Conclusions.—From the above figures it is concluded that the rapid drying of *Robusta* coffee seed by placing it directly in the sun is detrimental to the germination powers of the seed if prolonged for more than one day.

MISCELLANEOUS PLANTS AND CROPS.

Picralima.—Many of these trees have continued to produce fruits, and 10 lbs. of seed were forwarded for chemical tests.

Tung Oil.—Two of the nine Tung Oil trees planted out in 1930 (*Aleurites fordii*) have died. The remainder, and the single specimen of *A. montana*, have grown well.

Dillenia indica.—The three *Dillenia* trees (*Dillenia indica*) planted out near the store shed in 1930, have grown very well.

Date Palms.—Four Date Palms (two Siwi and two Amhat date) were received from Egypt and planted out in July.

Niger Oil.—A small quantity of Niger Oil seed (*Guizotia* sp.) was obtained from Kenya, to be tried as a cover crop. The seed germinated excellently and the growth of the plants was good and rapid. A larger area was subsequently planted up in order to increase the amount of seed.

Sugar Cane.—The varieties of sugar cane were maintained throughout the year, but larger amounts of P.O.J. 2727, P.O.J. 2878 and P.O.J. 2725 were included.

Jute and Flax.—Small areas of jute and flax have been sown by the Botanist, mainly for seed increase purposes.

Eucalyptus.—Fresh eucalyptus seedlings were planted out in the established block below the terraces. A small area on the other side of the nursery beds has also been planted up with seedlings.

Extension and New Boundary.—A fairly extensive area situated below the sugar cane has been brought under cultivation during the year. The soil, if well drained, is good, and has been used chiefly by the Botanist for oil and fibre crops.

The southern boundary of the plantation has been altered so as to run in a straight line from the top corner of Plot No. 1 to the cattle kraal. The old tea plot (near the plantation house) and a considerable area of Para rubber is now outside the boundary.

NURSERY.

The usual routine work has been carried on in the nursery, consisting chiefly of the raising of coffee plants and fruit trees for distribution purposes. Some of the beds were given an application of lime in May and June.

The following plants and seeds were distributed during the year :—

	COFFEA ROBUSTA.		FRUIT TREES.	TEA SEED.		VARIOUS ECONOMIC.		VARIOUS DECORATIVE.		
	Plants. No.	Seeds. lbs.	No.	Plants. No.	Seeds. lbs.	Plants. No.	Seeds. lbs.	Plants. No.	Seeds. lbs.	Cuttings No.
To : Natives ...	3,705	—	330	—	—	—	—	—	—	—
„ District Nurseries	600	67	—	—	—	—	—	—	—	—
„ School Gardens ...	50	—	125	—	—	—	32	—	—	900
„ Others ...	12,359	125	4,565	12	108,497	402	217	163	5	—

Gliricidia maculata.
Poles.

To others ... 130

R. W. STUCKEY,

Agricultural Officer.

ANNUAL REPORT ON THE BOTANIC GARDENS, ENTEBBE.

METEOROLOGICAL.

The meteorological work of the Protectorate which had previously been carried out by this Department at Entebbe, was handed over to the East African Meteorological Service in April, the recording of the readings in the Observatory at Entebbe being performed by the Geological Department.

The total rainfall for the year—67·38 inches—was 8·14 inches above the average annual rainfall, it being the highest record since 1926, when 75·28 inches of rain were recorded.

The wettest month was May, when 13·22 inches of rain fell, this amount being 4·01 inches above the average for May. The lowest rainfall occurred in December, when only 1·41 inches were registered, which is 3·39 inches below the average rainfall for December.

The monthly average maximum temperatures for the first half of the year were higher than in the previous year, but the remainder of the months varied little from normal.

OIL PALMS.

Individual records of seed produced for the year of all the palms have been kept and tabulated each month.

The average number of seeds collected each month—excluding May, when no collection was made—was 4,983 seeds weighing 177 lbs., the highest yield being obtained in April when 8,374 seeds were collected weighing 278 lbs. 14 ozs.

The highest yielder during the year was palm No. 12, which produced 1,872 seeds weighing 92 lbs. 12 ozs. This palm is also the highest yielder since records were first commenced, a total of 4,179 seeds weighing 248 lbs. having been collected in the four years.

The total number of palms in the plot at the commencement of the year was 137, of which 31 were cut out in August as they had never produced seed, leaving a total of 106 palms; of this number, 92 produced seed during the year, 14 of these being new yielders.

RUBBER.

The tapping of the selected trees in blocks Nos. 1, 2 and 3, which was being carried out to find the best yielders, was discontinued at the end of the year as sufficient data has now been obtained for the purpose. The highest yielders were trees Nos. 2, 3 and 6 in Block No. 1; these trees have now been pollarded to obtain material for budding.

The individual records of these selected trees in each block have been tabulated for the whole period that the trees were tapped. The trees were tapped on a one-third surface left to right cut on alternate week-days.

A commencement was made in September to cut out the Para trees in Block No. 2, as the trees are no longer required. Good progress has been made, and as soon as all the trees are removed the plot will be dug over, levelled and laid down as a lawn.

HYDNOCARPUS.

The *Hydnocarpus Wightiana* which was planted in the plot near the store in May, 1927, has now commenced to flower and set fruit. The *H. anthelmintica* have not flowered yet, but continue to make good growth. This plot was planted out in March, 1929.

FRUIT TREES.

A total of 30 plants of two new varieties of pawpaw, which were raised at Kampala from seed received from His Excellency the Governor, were planted out in the fruit plot in November and have done quite well. The plants consist of eight of the small variety "Colo" and 21 plants of the large variety "Fincer Merr."

All the fruit trees which were planted out in May, 1929, have been pruned and most of them have made good progress during the year.

DISTRIBUTION OF PLANTS AND SEEDS.

The numbers of economic and decorative plants and seeds distributed during the year were as follows :—

		<i>Plants.</i>	<i>Seeds.</i> <i>Packets.</i>	<i>Bundles.</i>
Economic	...	2,009	9	2 Lawn grass.
Decorative	...	6,876	70	(9 Verbena. 8 Lantana cuttings.
TOTAL	...	8,885	79	19

The above total of economic plants includes the undermentioned fruit trees which were distributed during the free distribution in April :—

Avocado Pear	4	Loquat	41
Blackberry	49	Mangoes	57
Breadnut	1	Mulberry	47
Carambola	10	Orange	114
Grape Fruit	149	„ Mandarine	26
Golden Apple	5	„ Marmalade	49
Guava, Apple	58	„ Tangerine	74
„ Common	6	Pawpaw	77
„ Cherry, ...	35	Pitanga Cherry	93
„ Strawberry... ..	51	Pomelo	53
„ Plum	14	Raspberry	54
Jack Fruit	55	Rose Apple	49
Lemon, rough	94	Soursop	14
„ smooth	16	Strawberry	40
Limes	41	Tree Tomato	4
		TOTAL	1,380

LAWNS AND FLOWER BEDS.

All the lawns have been cut throughout the year with the three “long grass” machines and with the exception of the rainy season and during the short time that the machines were out of order, when no spares were available to repair them, the lawns have been kept in very good condition. The motor mowers were not used during the year.

The removal of the *Cacao* trees in Plot No. 3 has made a great improvement in the centre lawn, as the plot had occupied a prominent position there. The series of beds at the side of the old plot were also grassed down as they were no longer required.

A commencement was made in December to clear the part of the old forest arboretum above the fruit plot near the tool store. The plot is being dug over, levelled and grassed down to make a new lawn. Specimens of all fruit trees which are at present growing in various parts of the Gardens will be planted out on this lawn to form a fruit collection.

All beds and borders have received the necessary attention and have been kept up to a good standard, dressing of leaf mould having been applied to most of the beds.

The roses on the bank in the Rose Garden have been removed and the beds filled in and grassed down.

Beds containing annuals have been replanted with plants such as rose, salvia, cannas, clerodendron, etc.

The following is a list of new plants that have been raised and which were planted out in the Gardens during the year :—

1 <i>Mesua ferrea</i> (planted in bed on lawn above rose garden).	
8 <i>Arum italicum</i>	} planted in fernery.
2 <i>Arum hygrophilum</i>	
52 <i>Lilium regale</i>	
2 <i>Monstera deliciosa</i>	
19 <i>Aloe arborescens</i> var. <i>natalensis</i>	} planted on rockery.
1 <i>Aloe arborescens</i> var. <i>frutescens</i>	
8 <i>Aloe abyssinica</i> x <i>striata</i>	
8 <i>Cereus jamacaru</i>	
1 <i>Opuntia cylindrica</i>	

E. A. RUCK,

Plantation Manager.

**List of Circulars obtainable from the Director of Agriculture,
Entebbe:—**

*Circular
Number.*

3. DISEASES OF *HEVEA BRASILIENSIS* IN UGANDA.
4. DIEBACK OF *COFFEA ARABICA* IN UGANDA.
7. REPORT ON COFFEE CULTIVATION IN UGANDA.
14. *COFFEA ROBUSTA* IN UGANDA.
15. CULTIVATION AND PREPARATION OF *COFFEA ROBUSTA*.
16. COTTON EXPERIMENTS 1925—1926.
17. (A) THE OCCURRENCE OF ANGULAR LEAF-SPOT OF COTTON
IN UGANDA.
(B) ROT OF *HEVEA* CORTEX IN UGANDA.
18. RUBBER EXPERIMENTS ON THE GOVERNMENT PLANTATION, KAMPALA.
19. SUGAR CANE IN UGANDA.
20. NOTES ON THE CULTIVATION, CURING AND PACKING OF
FIRE-CURED TOBACCO.
21. SOIL MANAGEMENT AND MANURING.
22. VARIEGATED COFFEE BUG (*ANTESTIA SPP.*)